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ON SOME

# NEW BATRACHIA AND REPTILIA

FROM THE

## PERMIAN BEDS OF TEXAS;

## ON A WADING BIRD FROM THE AMYZON SHALES;

## ON THE NIMRAVIDÆ AND CANIDÆ OF THE MIOCENE PERIOD;

AND

## ON THE VERTEBRATA OF THE WIND RIVER EOCENE BEDS OF WYOMING.

BY

E. D. COPE.



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WASHINGTON, February 11, 1881.

## Art. II.—On some new Batrachia and Reptilia from the Permian Beds of Texas.

By E. D. Cope.



PANTYLUS CORDATUS gen. et sp. nov.

*Char. gen.*—Represented by one species, which is as yet only known from crania. In these the superficial ossification is complete, leaving only nostrils, orbits, and parietal fontanelle. Surface sculptured. Mandible with an angular process. Teeth shortly conic, obtuse, and without grooves or inflections, increasing in size towards the anterior parts of the jaws. Mandible supporting several rows of teeth, which oppose a pavement of obtuse teeth on the palate. These are situated on either the palatine or anterior part of the pterygoid bones. Quadratojugal and malar bones well developed. No lyra or mucous grooves.

This genus is first of the *Stegocephali* from the Permian formation of Texas, whose cranial structures indicate a habit of obtaining nutriment by crushing hard bodies. Without vertebræ it is not possible to ascertain whether it pertains to the Microsaurian, Embolomeran or Ganocephalous divisions. It may be compared with the *Sparodus* of Fritsch in the general characters of its dentition, but may be easily distinguished from it by the numerous series of teeth on the mandibular rami. Some of these are on the dentary bone, while others are on an inner element, but whether opercular or splenial I cannot now determine.

*Char. specif.*—The skull of the *Pantylus cordatus* is about as large as that of a fully grown snapping tortoise, *Chelydra serpentina*, and has somewhat the same form of outline. The vertex is flat; the postorbital region is swollen, and the muzzle is abruptly acuminate. The orbits are lateral with a slight vertical exposure, and are widely separated. The front is deflected from opposite their posterior margins, and the muzzle protrudes considerably beyond the lower jaw. The premaxillary bones form a triangle whose apex does not appear on the superior surface of the muzzle, and the nares are rather close together, and lateral in their vertical presentation. The upper surface of the extremity of the snout is occupied by the large nasal bones, which are followed by the larger frontals. The lachrymal and prefrontal are both well developed, the latter extending backwards to meet the postfrontal near the middle of the superior border of the orbit. The posterior border of the skull is damaged, but enough remains to show that it was concave.

The symphysis mandibuli is short. The rami are wide, and are flat below, the inferior surface forming a rounded right angle with the interior surface. The angular process is in line with the external border of the ramus.

The sculpture of the cranium proper is strong, consisting of pits separated by strong, narrow ridges, forming a honeycomb pattern. The fossæ are smaller on the buccal regions. On the anterior part of the mandible the fossæ are distinct; on the median and posterior part the ridges become linear. A narrow triangular space on the external side posteriorly, with its long apex on the inferior margin, is smooth.

There are two subequal obtuse teeth, on the border of each premaxillary bone. I cannot count the number on the maxillary, but there are four anterior to the line of the anterior border of the orbit. Of these the next to the anterior one is larger than the rest, though of the same shortly-conic, obtuse form. These teeth are rather large for the size of the skull. At a point near the middle of the ramus of the mandible, where it is broken off, there may be counted five teeth in a transverse series. Of these the second from the external border is the largest, and has a regularly rounded crown. Six teeth may be counted on a transverse fracture of the palatine bone. Of these the four external have obtusely rounded crowns, and the third from the external border is the largest. The crowns of all the teeth are hollow.

*Measurements.*

| | M. |
|---|---|
| Length of cranium to transverse line connecting posterior borders of quadrates | .077 |
| Width between same points | .082 |
| Length of axis of cranium to line connecting anterior borders of orbits | .018 |
| Interorbital width | .032 |
| Longitudinal diameter of orbit | .016 |
| Length from orbit to nostril | .015 |
| Projection of muzzle beyond mandible | .010 |
| Length of alveolar edge of premaxillary | .007 |
| Height of crown of large maxillary tooth | .0045 |
| Fore-and-aft diameter of maxillary | .0035 |
| Width of mandibular ramus below at middle | .020 |

This species considerably exceeds in size those referred by Dr. Fritsch to *Sparodus*, as it was probably rather larger than the *Protonopsides* of recent waters. Its physiognomy is peculiar, as the prominent muzzle and lateral orbits are unusual among Batrachia.

DIMETRODON SEMIRADICATUS sp. nov.

A considerable part of the skull and some limb bones represent this species. There are no vertebræ referable to the specimen, but the two maxillary and premaxillary bones support nearly all the teeth in an excellent state of preservation. Continuity of the dental series is preserved by one maxillary bone or the other, excepting just at the extremity, where there is a slight interruption on both sides. On one of them it must be very slight.

There are three teeth in each premaxillary bone. In the maxillary I count seventeen, with the bare possibility of a necessity for adding one more. The first premaxillary and third maxillary teeth are of nearly equal size and are much larger than the others, the second premaxillary only approaching them. The section of the base of the first premaxillary is subtrifoliate, there being one grove on the inner, and two on the external face. The section of the middle of the crown is more than a semicircle, with the base convex. The two angles are the sections of two ridges which are both presented posteriorly, the one on the inner the other on the external face of the crown. The crown of the second premaxillary has the same form, but the base has only slight traces of the grooves. The third premaxillary is a diminutive of the second.

The crowns of the maxillary teeth differ from those of the premaxillaries in the opposition of the cutting edges, which present anteriorly and posteriorly. The external face is more convex than the internal. The crown of the large third tooth is not expanded above the root, but its antero-posterior diameter contracts regularly to the apex. The crowns of the other teeth are wider at the base antero-posteriorly than the root. They are all slightly curved backwards, and their edges are more or less regularly crenate.

Several peculiarities distinguish this species from the *D. incisivus*, with which it agrees in size. In the first place, the section of the root, at and below the base of the crown of the third or large maxillary tooth and of the seventh tooth posterior to it, is of the form of a figure ∞ directed antero-posteriorly. This is due to the deep grooving of the tooth on the opposite sides at this point; the grooves not extending on the crown. The grooves are deeper on the smaller teeth, giving it an almost biradiculate character. In *D. incisivus* the sections of these teeth are subquadrate.

In the second place, the section of the base of the first incisor differs from that in *D. incisivus*, where it is subquadrate with two subopposite shallow grooves. Next, the nostril excavates the border of the maxillary bone; in *D. incisivus*, the nostril is separated from that bone by the intervention of the nasal. In that species there are but two premaxillary teeth; in *D. semiradicatus*, there are three. The teeth which accompany specimens of *D. cruciger* have the same form and proportions as those of the *D. incisivus*.

*Measurements.*

| | M. |
|---|---|
| Length of dental series | .252 |
| Length of premaxillary series (and bone) | .049 |
| Length of diastema | .024 |
| Length of first premaxillary tooth from alveolar border | .057 |
| Diameter of first premaxillary tooth at alveolar border { anteroposterior | .022 |
| Diameter of first premaxillary tooth at alveolar border { transverse | .015 |
| Length of third maxillary from alveolar border | .067 |
| Diameter of third maxillary at alveolar border { anteroposterior | .020 |
| Diameter of third maxillary at alveolar border { transverse | .005 |

| | | M. |
|---|---|---|
| Diameter of third maxillary at base of crown | anteroposterior | .018 |
| | transverse | .015 |
| Length of seventh maxillary from alveolus | | .026 |
| Diameters of crown at base of cutting edges | anteroposterior | .012 |
| | transverse | .009 |

The approximation to a two-rooted condition in some of the teeth is a marked peculiarity of this species. The median groove is most extensive on the smaller maxillary tooth, extending into the base of the crown. From observation on this species and on certain *Dinosauria*, I am under the impression that the two-rooted mammalian tooth is the result of constant absorption of the median portion of the wide root of a wide crown, due to the presence and pressure of the successional tooth.

DIMETRODON CRUCIGER Cope, Paleontological Bulletin No. 32, p. 7.

This species was abundant during the Permian period. One of the best preserved individuals in my collection is represented by the greater part of the vertebral column and the pelvic and scapular arches.

The pelvic arch resembles that of the *D. gigas* in its general characters. For a description of the latter see Paleontological Bulletin No. 32, p. 6. The scapular arch also agrees with the descriptions I have given, but possesses some parts which have been hitherto wanting. These are the clavicles, as I suppose them to be. Each of these consists of a horizontal portion and an ascending portion. The former is nearly a quarter of a circle in form, with its convex outline presenting inwards and backwards. The border is marked by radiating ridges which terminate in a suture like rugosity of the edge. The lower surface curves rapidly into the ascending portion, which is narrow and acuminate and about twice as high as the horizontal portion extends inwards from its interior border at the base. It displays on its external border an extensive sutural surface for union with the scapula. The anterior extremity of the epicoracoid lies on the superior (internal) face of the horizontal portion of the clavicle, extending nearly to its anterior border. Its external margin thins out in contact with the clavicle.

The above structure is peculiar among *Reptilia* in the widely-expanded subtriangular distal part of the clavicle. It presents no greater resemblance to any known mammal. Its character is more that of the Stegocephalous *Batrachia*, and it is a good deal like the lateral thoracic shield of the animals of that group, as, for instance, *Actinodon* of Gaudry and *Cricotus* m. From the sutural character of the borders of this part I anticipate the discovery of a median or mesosternal element. It is possible that the piece attached to its superior face, which I have above alluded to as epicoracoid, may be a part of this bone displaced laterally.

The resemblance of the humerus of this and of allied genera to that of the mole was reported by the writer in the American Naturalist, 1878, p. 408 (June), and the nearer resemblance to *Echidna* was asserted in the same journal, 1878, p. 830 (December).

## Art. III.—On a Wading Bird from the Amyzon Shales.

By E. D. Cope.

The formation which I have called the Amyzon Shales is a lacustrine deposit of Tertiary age which is found in the South Park of Colorado, in Northeastern Nevada, and probably in Central Oregon.* Its material is laminated, and is occasionally highly carbonaceous. It contains many specimens of fossil fishes, of plants, and of insects, and allied articulates. Its age is uncertain, but it is probably near the Upper Eocene or Lower Miocene. Remains of birds are very rare, the best-preserved specimen yet found being that of a Passerine species. Under the impression that it belongs to the *Fringillidæ*, Mr. J. A. Allen describes it under the name of *Palæospiza bella*.†

The present communication relates to a second species of bird from the same formation. The specimen includes three vertebræ anterior to the pelvis; the pelvis, with the vertebræ which it incloses, and the caudal vertebræ; both femora; the tibia and part of the tarsometatarse of the right leg, with the greater part of the left tibia. One-half of the tail is preserved, the feathers lying in almost undisturbed relation. There are also various light and downy feathers of the base of the tail and adjacent parts of the body lying on the block, some in place, others loose.

The characters displayed by the bones and feathers are those of a species of the order *Grallæ* and tribe *Limicolæ* (*Totanideés* A. Milne Edwards). In the absence of important parts of the skeleton, it is not possible to ascertain the family characteristics, but it is more easy to assign the species to its genus. I cannot detect any features which forbid its reference to the genus *Charadrius* in the large sense. It presents important resemblances to the species of *Totanus*, but there are some reasons, to be mentioned later, why this reference is inadmissible. It is clear that there are various genera of *Scolopacidæ* to which it cannot be referred, on account of the form of its *ossa ischii*. I therefore introduce it to the scientific record under the name

CHARADRIUS SHEPPARDIANUS.

*Chars.*—Femur one-half the length of the tibia; nine caudal vertebræ; tail gently wedge shaped, apparently without color cross-bars.

* American Naturalist, May, 1879.

† Bulletin U. S. Geol. Survey Territories, Vol. IV, 1878, p. 443, Pl. I.

*Description.*—The preiliac vertebræ are distinct from each other and have only moderately elongate centra. The diapophyses are of moderate length and less width, and are truncate at the extremity. Those of successive vertebræ are connected by but few osseous ligamentous spicules. The caudal vertebræ are short and wide, and have short diapophyses, except the first, which has a long narrow diapophysis. The last three are in profile, and do not display hypapophyses. The ploughshare bone is an elongate triangle, considerably produced to its superior angle. The basal cotylus for articulation with the centrum immediately infront, is well excavated.

The pelvis is short and rather wide posteriorly. The fossil presents a superior view of it, with both the pubic bones turning their external faces upwards. The external borders of the anterior plates of the ilia are broken away, but enough remains of their inner portion to show their anterior extent. The postacetabular ridges diverge outwards and terminate in a prominent angulation of the posterior border which is about equidistant between the vertebral border of the ilium and the externo-inferior border of the pubis. The posterior outline thus differs from that seen in various genera of *Scolopacidæ*, where the angle is much nearer the vertebral border, and where a second angle is produced by a notch at the point of junction of the ischium. The pelvis of *Totanus* is however, much like that of the present species. External to the angular projection described, the border is notched, and then turns posteriorly, forming a gentle curve, which continues from the ischium to the slender pubis. The pubis is long and very narrow, and extends well posterior to the ischium. It is of uniform diameter, and is not expanded distally. The ischiopubic foramen is long and narrow, about one-seventh as wide as long. The obturator foramen is about one-third the length of the ischiopubic, and is oval. A transverse line cutting the anterior border of the acetabulum divides the pelvis between the posterior angular projection of the ilium (the true crest, *fide*, Gegenbaur) and the anterior extremity, into two parts of equal length.

The leg bones are quite slender, and are similar in proportions to those of several species of *Charadrius* and *Totanus*. They are more slender than in various species of *Scolopax*, *Strepsilas*, *Tringa*, &c., and less so than in *Himantopus* and *Recurvirostra*. The former is just half as long as the tibia, and seen in profile is almost straight. The crest of the tibia is very prominent, but is not produced proximally. The distal extremity of the tibia and proximal part of the tarsometatarse are so damaged as not to furnish satisfactory characters.

There are five rectrices visible in the specimen. Those which are in all probability median are the longest, while the external two are of equal length. This gives the outline a rather short wedge shape as the feathers lie closed. The expanded tail would be rounded with a slight median angulation. The extremities of the feathers are rounded, and

their whole structure is soft and delicate. The length of the longest rectrix is just about that of the tibia.

*Measurements.*

| | M. |
|---|---|
| Length of the preiliac vertebræ | .010 |
| Length of centrum of first vertebræ | .0035 |
| Length of sacrum | .021 |
| Length of caudal vertebræ on curve | .0145 |
| Length of plowshare bone to apex | .005 |
| Length of ilium | .024 |
| Length of ilium to acetabulum | .012 |
| Length of ischium from acetabulum | .016 |
| Length of pubis from acetabulum | .019 |
| Width between posterior angles of ilia | .009 |
| Length of femur | .024 |
| Diameter of femur at middle | .003 |
| Length of tibia | .047 |
| Antero-posterior diameter at head | .006 |
| Diameter of shaft at middle | .0027 |
| Diameter of head of tarsometatarse | .004 |
| Length of median rectrix from plowshare bone | .046 |
| Length of external rectrix from plowshare bone | .040 |
| Width of portion of tail preserved | .020 |

The strongly contrasted light and dark shades of color are not unfrequently preserved in the insects of this formation. I suspect that had the rectrices of this species originally displayed the alternating white and dark cross-bars characteristic of the *Totani*, some trace of them would be discoverable in the fossil, in spite of the fact that the entire feather is represented by carbon only. The brown tint of the specimen, both light and dark, is uninterrupted by pattern of any kind.

The tail is rather longer than in the *Tringæ*, about equal to that of many plovers and *Totani*, and shorter than that of *Actiturus*.

The *Charadius sheppardianus* was discovered near Florissant, Colorado, by Dr. G. Hambach, a skillful naturalist. I have named it in honor of Edwin Sheppard, of Philadelphia, an excellent ornithologist and skillful artist.

# Art. VII.—On the Nimravidæ and Canidæ of the Miocene Period.

By E. D. Cope.

In following the general series of the *Carnivora*, we pass, as in other orders, from the generalized to the specialized types. That we should begin with the *Procyonidæ* and their allies is indicated by all the characters to be especially considered in the case. They have five toes on all the feet, and are plantigrade, resembling in these points all primitive *Mammalia*.* They have the original number of molar teeth, seven on each side, and of these none are distinctly developed sectorials. The condyloid and carotid foramina are distinct, and there is a postglenoid foramen. If, starting from this point of departure, we arrange the succeeding families of *Carnivora* according to their resemblances and differences in these respects, we have a tolerably consecutive series of divisions.

Passing at present over the families *Mustelidæ*, *Viverridæ*, *Cryptoproctidæ*, and others with five toes on all the feet, we reach those in which the hind foot has lost a digit, leaving the number 5–4. These are the *Protelidæ*, *Canidæ*, and *Felidæ*. We can take but one step further in this order; that is to those species where the anterior foot has also lost a toe, which constitute the family *Hyænidæ*. The toes are therefore, here, 4–4. For the well-marked characters of the three families mentioned just before, I refer to another page, and proceed to define briefly the division which has been heretofore termed the *Felidæ*. In doing so I am compelled to omit several of the characters generally employed to define that family, since I have found them to be wanting from various extinct genera. The only comprehensive definition which I can give is the following:

*Digits 5–4; sectorial teeth well developed in both jaws; not more than one true molar tooth in the upper nor more than two true molar teeth in the lower jaw. Glenoid cavity grasping mandibular condyle anteriorly as well as posteriorly.*

Professor Gill, who has devoted much attention to the definition of the families of the *Mammalia*,† gives the following skeletal characters

* See Homologies and Origin of Types of Molar Teeth of Mammalia Educabilia, Journal Academy Phila. 1874, March.

† Arrangement of the Families of Mammals, Smithson. Miscell. Coll. 230, 1872, p. 56.

in his diagnosis of the *Felidæ*, and of the three comprehensive divisions within which he places it: "I. Skull with the paroccipital process applied closely to the auditory bulla; the mastoid process small or obsolete; external auditory meatus very short or imperfect. Div. A. Carotid canal minute and superficial or obsolete; condyloid foramen and foramen lacerum posticum debouching into a common fossa; glenoid foramen minute or null. Os penis rudimentary. Subdiv. 1. Otic bulla divided by a septum into posterior and anterior chambers, communicating by a narrow aperture (Flower). Subdiv. *a*. Skull with no alisphenoid canal." All of the parts above mentioned I have found to be important in the definition of the natural divisions of the *Carnivora*, excepting those derived from the paroccipital and mastoid processes. But their condition in the extinct *Carnivora* which have been hitherto arranged with the *Felidæ*, and which resemble them very much in superficial characters, does not coincide with Professor Gill's definition. Thus, in the various American genera which are allied to *Drepanodon*, the carotid canal is distinct from the *foramen lacerum posterius*, and the condyloid foramen is also separated from it by quite a space. These are characters which belong to most of the *Carnivora* with five digits on all the feet. Further, the postglenoid and postparietal foramina are present; also characters of the lowest *Carnivora*, as the bears and certain extinct dogs. Then, there is an alisphenoid canal, which is also found in bears, dogs, and the cat-like *Cryptoprocta*. I cannot demonstrate that the otic bulla is divided, as the above diagnosis requires, in any of the fossil species. I have verified these characters on species of the following genera, of which I have well-preserved skulls: *Archælurus*, *Nimravus*, *Dinictis*, *Pogonodon* (except those of the basal axis of the skull), and *Hoplophoneus*. Three genera as yet only found in Europe are similar in general characters, and probably agree with them. I allude to *Proælurus* Filh., *Ælurogale* Filh., and *Eusmilus* Gerv. On the other hand, the genus *Smilodon*, which includes the American saber-tooths of Pliocene age, agrees with the true cats in the points in question; *i. e.*, the alisphenoid, postglenoid, and postparietal foramina are wanting, the carotid foramen is either internal or wanting, and the condylar enters the jugular foramen at its mouth. This surprising condition of affairs makes it important to learn the characters to be found in the species of the longest-known genus, *Drepanodon*, of the European beds. But although there are several good crania in European museums, I can find no description of their minute characters, and no mention made of their foramina. The probabilities are, on various grounds, that this genus agrees with *Smilodon* in the latter characters. The reasons in favor of this supposition are the agreement in special dental characters, and the Pliocene age of the typical species, *D. cultridens*. Whether the middle Miocene species of Sansan and Epplesheim agree with this one in structure, is of course uncertain.

Seven, and perhaps eight, genera, then, constitute a group to be dis-

tinguished from the true *Felidæ*, and, as it appears to me, as a distinct family. Should we ignore the characters adduced in this instance, we abandon at the same time the definitions of several of the other families of the order, and in fact throw the system into confusion. I have proposed to call this family the *Nimravidæ*, and have contrasted it with the *Felidæ* in the following definition. Both are included in the division already defined on a preceding page.

No distinct carotid foramen nor alisphenoid canal; condylar foramen entering the foramen lacerum posterius. No postparietal and generally no postglenoid foramina ..... *Felidæ.*

Carotid and condylar foramina entirely distinct from the foramen lacerum posturius; an alisphenoid canal, and postglenoid and postparietal foramina ..... *Nimravidæ.*

### NIMRAVIDÆ.

The dental characters of the *Nimravidæ* are in general, those of the *Felidæ*, the higher genera having the same dental formula. Descending the scale, the number of molar teeth increases at both ends of the series in the lower jaw, and anteriorly only in the upper, but the number of the true molars never exceeds $\frac{1}{2}$. The following table gives the definitions of the genera. I am unfortunately ignorant of the characters of the foramina in *Proælurus* and *Pseudælurus*, as well as in *Ælurogale* and *Eusmilus.*

I. Lateral and anterior faces of mandible continuous; no inferior flange.
  *a.* Inferior sectorial with a heel; canines smooth.
    Molars $\frac{4}{4}\ \frac{1}{2}$; inferior sectorial with interior tubercle ..... *Proælurus.*
    Molars $\frac{3}{3}\ \frac{1}{1}$; inferior sectorial without interior tubercle ..... *Pseudælurus.*

II. Lateral and anterior faces of mandible separated by a vertical angle; no inferior flange; incisors obspatulate.
  *a.* No anterior basal lobe of superior sectorial; inferior sectorial with a heel (and no internal tubercle); incisors truncate.
    Molars $\frac{4}{3}\ \frac{1}{2}$; canine smooth ..... *Archælurus.*
    Molars $\frac{3}{3}\ \frac{1}{2}$; canine denticulate ..... *Ælurogale.*
    Molars $\frac{3}{2}\ \frac{1}{2}$; canine denticulate ..... *Nimravus.*

III. Lateral and anterior faces of mandible separated by a vertical angle; an inferior flange; incisors conic; canines denticulate.*
  *a.* No anterior basal lobe of superior sectorial; † inferior sectorial with a heel; no posterior lobes of the crowns of the premolars.
    Molars $\frac{3}{3}\ \frac{1}{2}$ ..... *Dinictis.*
    Molars $\frac{3}{3}\ \frac{1}{1}$ ..... *Pogonodon.*
    Molars $\frac{2-3}{2}\ \frac{1}{1}$ ..... *Hoplophoneus.*
    Molars $\frac{?}{1}\ \frac{?}{1}$ ..... *Eusmilus.*

It is readily perceived that the genera above enumerated form an unusually simple series, representing stages in the following modifications of parts: (1) In the reduced number of molar teeth; (2) in the

* Gervais's figures of the canines of *Eusmilus bidentatus* represent no denticulations, but the figure is not clear.

† Rudimental in *Hoplophoneus.*

enlarged size of the superior canine teeth; (3) in the diminished size of the inferior canine teeth; (4) in the conic form of the crowns of the incisors; (5) in the addition of a cutting lobe to the anterior base of the superior sectorial tooth; (6) in the obliteration of the inner tubercle of the lower sectorial, and (7) in the extinction of the heel of the same; (8) in the development of an inferior flange and latero-anterior angle of the front of the ramus of the lower jaw; (9) in the development of cutting lobes on the posterior borders of the larger premolar teeth.

(1) The reduction in the number of molar teeth. The dental formula of *Proælurus* is that of some *Viverridæ* and *Canidæ*, and the reduction from this point to the end of the series is obvious. In *Eusmilus*, as in *Smilodon*, the number of molars is less by one in the inferior series than in *Lynx* and *Neofelis*, where the formula is the smallest known among *Felidæ* proper, viz: $\frac{3}{2}$ $\frac{1}{1}$. (2) The enlarged size of the superior canine teeth. In *Proælurus* and *Pseudælurus* the canines of both jaws are developed, as in recent *Felidæ*. In *Archælurus* the superior is the larger, but does not, relatively to the molars, exceed that of *Felis*. It is rather compressed in form and has a sharp cutting edge posteriorly. In *Nimravus* the superior canine begins to have the enlarged size of the saber-tooths, but its form is peculiar in the *N. gomphodus*, being spike-shaped rather than saber-shaped. We find the true saber shape first in *Dinictis*, where it is compressed, and with a denticulate cutting edge on both front and rear. In *Pogonodon* it has reached a very large size, and it does not display much increase in this respect until we reach the last genus of the series, *Eusmilus*, where its proportions are enormous, almost as large as in the feline genus *Smilodon*, where they appear to have been an inconvenience to the animal. (3) The diminished size of the inferior canines becomes evident in the lower genera of the third division (supra) of the *Nimravidæ*, but is most decided in the highest genera, *Hoplophoneus* and *Eusmilus*. (4) The incisor teeth have the usual obspatulate or obovate outline in the genera of the first and second divisions of the family, including *Nimravus*. They are conic in the true saber-tooths with flared lower jaw, beginning with *Dinictis* and ending with *Eusmilus*. (5, 6, and 7) The structure of the sectorials. The presence of a heel and an inner tubercle of the lower sectorial are well-known characters of a majority of the *Carnivora*. In only the most highly organized genera are they wanting, and among them are included all those of the *Felidæ* that still exist. In the *Nimravidæ* the inferior genera have both in a reduced degree, and they soon disappear as we ascend the scale. Thus, the inner tubercle is only present in the species of *Proælurus*, *Dinictis*, and *Hoplophoneus*. The heel, on the other hand, remains throughout the entire family. The anterior basal lobe of the superior sectorial has the same history, its absence being characteristic of the inferior *Carnivora*, and of all the genera of *Nimravidæ* except *Hoplophoneus*, where it is rudimental. It is well developed in *Drepanodon* as in recent *Felidæ*, and is sometimes double in *Smilodon*. (8) The

development of the inferior flange and latero-anterior angle of the mandibular ramus. There is a successive advance in the development of these characters, beginning with the second group, for in the first they are wanting. The latero-anterior angle is developed in *Archælurus* and allied genera, and is merely continued on the inferior border of the ramus. In the third group it is much more acute, and is deflected downwards, forming the well-known flange of the saber-tooths. It is longest in the *Eusmilus bidentatus* Filh. (9) The highest genera of *Nimravidæ*, e. g. *Hoplophoneus*, differ from the true *Felidæ* in the absence of the cutting lobes on the posterior edges of the crowns of the larger premolar teeth. But, according to Filhol, these lobes are present in the generalized genera *Proælurus* and *Pseudælurus*, which are thus brought into a relation with the *Felidæ* not possessed by other *Nimravidæ*.

A characteristic perfection of the *Felidæ* is seen in the genus *Smilodon;* that is, the vertical direction of the ungual phalanges, by which the claws become retractile. This is well displayed by the two splendid specimens of *Smilodon necator* from Buenos Ayres, which have been preserved.* Unfortunately, these phalanges have not yet been described in any species of the *Nimravidæ*, and it is not yet certain what their structure really was. Among the true *Felidæ* the genus *Cynælurus* displays a less degree of development in this respect than the other genera, the ungual phalanges lacking the proximal process below the articular facet. Such a condition is to be looked for among the less perfect genera of *Nimravidæ*.

The succesion of genera above pointed out coincides with the order of geologic time very nearly. Those belonging to groups first and second belong to the Lower and Middle Miocene, except *Ælurogale*, which is perhaps Upper Eocene, and *Pseudælurus*, which is Middle Miocene. The genera of the first group of division third have the same Lower Miocene age, except *Eusmilus*, which has been found in the same formatation (Phosphorites) as the *Ælurogale*. *Drepanodon* is Upper Miocene, and *Smilodon* is Pliocene.

The relations of these genera are very close, as they differ in many cases by the addition or subtraction of a single tooth from each dental series. These characters are not even always constant in the same species, so that the evidence of descent, so far as the genera are concerned, is conclusive. No fuller genealogical series exists than that which I have discovered among the extinct cats.

As to the phylogeny of this family, there are flesh-eaters of the Eocene period which may well have been the ancestors of both the *Nimravidæ* and *Felidæ*.† I have suggested that this position is most appropriately held by the *Oxyænidæ*, a family of several genera, which included the most formidable, rapacious mammals of that early period in both continents.

* See American Naturalist, December, 1880, fig. 12.

† See On the Genera of the *Creodonta*, by E. D. Cope, Proceed. Amer. Philos. Soc. July, 1880.

The interval between them and the *Nimravidæ* is, however, great, for in the *Oxyænidæ*, when there is a superior sectorial tooth, the first true molar in the upper jaw is utilized instead of the last premolar, and the second true molar below is a sectorial as well as the first. Several intervening forms must yet be found to complete the connection, if it have ever existed. It is, however, very likely that the true *Felidæ* were derived from the genus *Procælurus*, through *Pseudælurus*, if indeed these two genera be not the primitive members of that family, for, as above remarked, the evidence of their possession of the characters of the *Nimravidæ* has not yet been obtained. There can be no reasonable doubt that the genera *Drepanodon* and *Smilodon* in the *Felidæ* are the descendants of *Hoplophoneus* and allied genera. In fact, the *Nimravidæ* and *Felidæ* are "homologous groups", having corresponding terms in the manner I foreshadowed as a general principle in 1868 (Origin of Genera).

In looking for causes in explanation of the modifications of structure cited, one can easily discover that there is a close relation between the arrangement of the teeth and the mechanical laws involved in the performance of their function, that of seizing an active prey and of cutting up their carcasses into pieces suitable for swallowing. It is obvious that in the latter case the flesh-teeth bear the resistance and the masseter muscle is the power, and that the nearer these parts are together the better is the function performed. As a matter of fact, the sectorial teeth in modern *Carnivora* are placed exactly at the angle of the mouth, which is nearly the front border of the masseter muscle.

Both the muscle and the teeth have, however, moved forwards in connection with the shortening of the jaw behind. This has been due to the necessity of bringing the power (masseter) nearer to another point of resistance, viz, the canine teeth. In the early carnivores (as *Hyænodontidæ*) the long jaws supported more numerous teeth ($^{4-3}_{4-3}$) than in any modern families, and the fissure of the mouth was probably very wide. The canine teeth were evidently very ineffective weapons. The animals probably only snapped with their jaws, and did not attempt to lacerate or hold on, as do the cats. The dogs of to-day are long-jawed, and they snap in a manner quite distinct from anything seen among the cats. The only dogs that hold on are the short-jawed bulldogs.

So in the use of the canines, we have the ground of the shortening of the jaw behind and before, and the consequent change of structure, which resulted in the modern perfected *Felidæ*.

The following list shows the number and distribution of the species of the *Nimravidæ*. The position of a cross on a line indicates an intermediate geological position.

| | Upper Eocene. | Lower Miocene. | | Upper Miocene. | | Pliocene. | |
|---|---|---|---|---|---|---|---|
| | Europe. | Europe. | America. | Europe. | America. | Asia. Europe. | America. |
| Prosælurus julieni Filh | | + | | | | | |
| Prosælurus lemanensis Filh | | + | | | | | |
| Pseudælurus hyænoides Blv | | | | + | | | |
| Pseudælurus edwardsi Filh | + | | | | | | |
| Pseudælurus intrepidus Leidy | | | | | + | | |
| Pseudælurus sivalensis Lydd | | | | | | + | |
| Archælurus debilis Cope | | | + | | | | |
| Ælurogale intermedia Filh | + | | | | | | |
| Ælurogale acutata Filh | | | | | | | |
| Nimravus gomphodus Cope | | | + | | | | |
| Nimravus confertus Cope | | | + | | | | |
| Dinictis felina Leidy | | | + | | | | |
| Dinictis cyclops Cope | | | + | | | | |
| Dinictis squalidens Cope | | | + | | | | |
| Pogonodon platycopis Cope | | | + | | | | |
| Pogonodon brachyops Cope | | | + | | | | |
| Hoplophoneus oreodontis Cope | | | + | | | | |
| Hoplophoneus primævus Leidy | | | + | | | | |
| Hoplophoneus occidentalis Leidy | | | + | | | | |
| Hoplophoneus cerebralis Cope | | | + | | | | |
| Eusmilus bidentatus Filh | + | | | | | | |

## DESCRIPTIONS OF NEW SPECIES.

### NIMRAVUS GOMPHODUS sp. nov.

*Nimravus brachyops* Cope, Proceed. Academy Philad. 1879, p. 170, not *Machærodus brachyops* Cope, Proc. Am. Phil. Soc. 1878, p. 72.

This carnivore is represented by parts of three individuals; one of them by a nearly complete skull. The species is rather larger than the average *Uncia concolor*.

*Measurements of skull.*

| | M. |
|---|---|
| Axial length from occipital condyles to premaxillary border | .206 |
| Axial length from inion to premaxillary border | .220 |
| Axial length from premaxillary border to canine tooth | .017 |
| Axial length from premaxillary border to anterior border of superior sectorial | .066 |
| Axial length from premaxillary border to posterior extremity of maxillary bone | .097 |
| Axial length from premaxillary border to postglenoid process | .162 |
| Length of nasal bone from nasal notch | .065 |
| Length of sagittal crest from inion | .082 |
| Width of premaxillary bone (greatest) | .019 |
| Width of each nasal bone at middle | .008 |
| Width of each frontal bone at middle of orbit | .028 |
| Width of each frontal bone at postfrontal angles | .035 |
| Width of skull at anterior part of zygoma | .098 |
| Width of zygomata at temporal fossa | .111 |
| Width of skull at meatus auditorius | .074 |
| Width of skull between apices of paroccipital processes | .054 |
| Width of occiput at middle | .044 |
| Width of foramen magnum | .024 |

| | M. |
|---|---|
| Elevation of occiput above foramen | .036 |
| Width of chin at base | .022 |
| Width of chin at summit | .028 |
| Depth of chin | .040 |
| Depth of ramus at diastema | .027 |
| Depth of ramus below last premolar | .031 |
| Length of ramus | .157 |
| Elevation of condyle | .033 |
| Elevation of coronoid process | .071 |
| Length of superior canine | .045 |
| Diameters of base of superior canine { antero-posterior | .016 |
| Diameters of base of superior canine { transverse | .008 |
| Anteroposterior diameter at middle | .010 |
| Distance from canine to third premolar | .016 |
| Length of molars, including third premolar | .045 |
| Length of base of third premolar | .018 |
| Elevation of cusp of third premolar | .013 |
| Length of base of sectorial | .025 |
| Elevation of cusp of sectorial | .015 |
| Width of tubercular | .009 |
| Elevation of inferior canine | .024 |
| Antero-posterior diameter of inferior canine at base | .012 |
| Length of inferior diastema | .022 |
| Length of inferior molar series | .063 |
| Length of third premolar | .0175 |
| Elevation of third premolar | .0175 |
| Length of fourth premolar | .020 |
| Elevation of fourth premolar | .015 |
| Length of sectorial | .025 |
| Elevation of median cusp of sectorial | .016 |

The characters of this species will be fully detailed in my final report to Dr. Hayden, now passing through the press.

From the John Day River, Oregon.

NIMRAVUS CONFERTUS sp. nov.

This species is as yet represented by a mandibular ramus only. It is one-third smaller than that of *N. gomphodus*.

The inferior border of the ramus is broken off, excepting for a space below the diastema. The general form is narrow, as in *N. gomphodus*, and there is a projecting ledge along the inner base of the sectorial similar to that seen in the latter species. The angle separating the side from the front of the ramus is rather stronger than in *N. gomphodus*, but there is no indication of an inferior flare. The diastema is shorter than in the typical species, its length equalling that of the base of the third (first) premolar; in *N. gomphodus* it is half as long again. The symphysis is correspondingly shorter, ceasing a little in advance of, and at the posterior border of, the inferior canine tooth, while in *N. gomphodus* it continues for one diameter of the canine behind its posterior border.

The crown of the inferior canine tooth is directed backwards, and its

serrate cutting edge is presented almost entirely inwards. The interno-anterior face of the crown is flat, and has a low shoulder at the base. The molars have the proportions of those of *N. gomphodus*, differing only in their smaller size, which is very apparent, as can be seen by the measurements. The first (third) premolar is a little longer on the base than high, has no anterior tubercle, and has a short cutting basal heel. The fourth premolar has subequal anterior and posterior basal cutting lobes, and the base is longer than the elevation of the median cusp. The sectorial tooth has a short cutting heel, but no trace of inner tubercle. The anterior lobe is as long as the median, but not so high. It overlaps the fourth premolar as far as the base of the median cusp. No incisor teeth are preserved in the specimen. Tubercular small.

*Measurements of skull.*

| | M. |
|---|---|
| Depth of ramus at diastema | .020 |
| Depth of chin | .027 |
| Elevation of inferior canine | .016 |
| Diameter of inferior canine at base | .010 |
| Length of inferior diastema | .014 |
| Length of inferior molar series | .053 |
| Length of third premolar | .014 |
| Elevation of third premolar | .010 |
| Length of fourth premolar | .016 |
| Elevation of fourth premolar | .013 |
| Length of sectorial | .022 |
| Elevation of median cusp of sectorial | .015 |

One specimen, from the John Day Valley, Oregon, found in the Truckee formation, by J. R. Wortman.

COLOREODON RYDERANUS sp. nov.

Represented by a nearly complete skull, without lower jaw. These indicate the third and smallest species of the genus. The specimen belonged to an adult animal, as indicated by the condition of the last two molar teeth.

Besides the small size, two characters may be cited as distinguishing this species from those already known. First, the temporal ridges converge very gradually, so that the sagittal crest does not appear anterior to the line of the otic bullæ, posterior to which point the skull is broken above. Second, the face is constricted immediately posterior to the position of the fundus of the alveolus of the canine teeth. The position of this alveolus is prominent, and occupies the superior half of the maxillary bone, which is excavated beneath it. This excavation is bounded behind by the infraorbital foramen. The lachrymal bone presents an angle into the orbit. The latter is open posteriorly, but the opposing processes approach each other. The zygomata are slender. The enamel of the molars is slightly wrinkled.

*Measurements of skull.*

| | | M. |
|---|---|---|
| Total length from left side of inion to front of canine | | .147 |
| From same to end of maxillary bone | | .075 |
| From same to palatal notch | | .087 |
| Length of diastema | | .011 |
| Length of molar series | | .059 |
| Length of true molars | | .035 |
| Diameters of second true molar | antero-posterior | .013 |
| | transverse | .015 |
| Diameters of third true molar | antero-posterior | .015 |
| | transverse | .019 |

The linear measurements of this skull are three-fourths that of *C. ferox*, and three-fifths that of *C. macrocephalus*.

Found by J. L. Wortman, on the John Day River, Oregon.

Dedicated to my friend John A. Ryder, of Philadelphia.

PALÆOCHŒRUS PLATYOPS sp. nov.

Established on a nearly complete skull, which lacks the muzzle anterior to the third premolar teeth, the lower jaw, and parts of the zygomata. The last superior molar is not protruded, and it is probable that the fourth deciduous premolar still remains in the jaw.

The size of this species exceeds that of any other member of the genus. The postorbital process is also more elongate, so as to inclose the orbit to a greater extent than is usual in *Palæochœrus*. The temporal ridges are strong, and rise into a convexity above the anterior part of the temporal fossa. From this point they converge gradually to form the sagittal crest, which has a truncate edge. Between the ridges the surface is concave, the basin widening forwards as far as a line passing through the posterior third of the orbits. The frontal bone rises steeply from the orbit to the edge of this basin, and is regularly convex in front of it. The profile descends forwards, so that the section at the infraorbital foramen is broadly convex, and not compressed, as in the species of *Palæochœrus* from the Truckee beds of Oregon. The emargination of the palate extends as far forwards as the line of the anterior border of the second true molar. The posterior border of the infraorbital foramen is above the middle of the anterior root of the fourth premolar. The postglenoid, mastoid, and postparietal foramina are present; the last named rather small and in the inferior part of the parietal bone.

The base of the fourth premolar is remarkably extended antero-posteriorly. Its crown has a posterior basal cingulum, and is in contact with those of the molars anterior and posterior to it. The crown of the first true molar is narrowed inwards, the anterior border being more oblique than the posterior. Both of these borders have a wide cingulum. There are two large external cusps, with antero-posterior continuous edges, two small median cusps, and a larger internal cusp. No internal or external cingula. The second true molar is also narrowed inwards, but less so than the first, and the posterior border is the only

oblique one. There are wide posterior and anterior cingula, and five cusps arranged as in the first molar. The internal cusp is relatively larger in this tooth.

*Measurements of skull.*

| | M. |
|---|---|
| Length from occipital condyles to anterior border of last premolar | .186 |
| Length from occipital condyles to palatal edge | .135 |
| Length from occipital condyles to line of anterior border of glenoid fossa | .051 |
| Width of occiput above | .046 |
| Width at posterior origin of zygomata | .071 |
| Width between orbits (least) | .077 |
| Width at middles of first molar teeth | .098 |
| Width between first molar teeth | .040 |
| Elevation of occiput, with condyles | .082 |
| Elevation of muzzle at front of fourth premolar | .043 |
| Diameters first molar, antero-posterior | .021 |
| Diameters first molar, transverse | .016 |
| Diameters second molar, antero-posterior | .022 |
| Diameters second molar, transverse | .019 |

This species is easily distinguished from those which have been discovered heretofore, by its large size, by the peculiar form of its molar teeth, and by its flattened muzzle. The specimen above described was discovered by Capt. Emmett Crawford, Third Cavalry, U. S. A., on the upper waters of the Big Cheyenne River, Dakota, in a bed of the White River formation. It was presented to me by Dr. William H. Corbusieur, U. S. A., to whom my especial thanks are due.

PROTOLABIS PREHENSILIS sp. nov.

This camel is supposed to have existed on the evidence of portions of the mandibles of two individuals. These include the symphyseal portion, and one of them the ramus as far posteriorly as the first true molar, inclusive. These remains indicate a robust species of the size of the *Procamelus angustidens*, or between the *P. gracilis* and *P. robustus*.

The most marked peculiarities of this species are the following: The canine and first premolar are very robust, and the latter is one-rooted and with an oval section at the base like the canine. The second premolar is also one-rooted, while the third and fourth are two-rooted, and differ very little in size from each other. The first true molar is abruptly larger, although narrowed in front. The root of the second premolar is round and of robust proportions, its diameter being one-half linear that of the first. The roots of the incisors are robust, that of the first being rather larger than that of the third. The symphysis terminates a little behind the line of the first premolar. The mental foramen is unusually extended in the antero-posterior direction.

*Measurements of skull.*

| | M. |
|---|---|
| Length of symphysis (No. 1) | .080 |
| Length of bases of incisors and canine | .043 |
| Diameters of canine, antero-posterior | .016 |
| Diameters of canine, transverse | .011 |

| | | M. |
|---|---|---|
| Diameters of premolar (I) | antero-posterior | .014 |
| | transverse | .009 |
| Length of last three premolars on base (No. 2) | | .034 |
| Length of base of fourth premolar | | .011 |
| Length of base of first true molar | | .019 |
| Length of first diastema (No. 2) | | .017 |
| Length of second diastema (No. 1) | | .026 |
| Depth at second diastema (No. 1) | | .033 |
| Depth at first true molar | | .048 |

The generic position of this species is uncertain. I place it provisionally in *Protolabis* on account of the large development of the inferior incisors. Its robust canine and first premolar, and small third and fourth premolar distinguish it from any of the species described.

Found by R. H. Hazard, in the Loup Fork beds of Southern Nebraska.

EUMYS LOCKINGTONIANUS sp. nov.

This rodent is represented by a nearly perfect skull, which is without lower jaw. Its specific characters separate it widely from the *E. elegans* Leidy and *E. nematodon* Cope. It is considerably larger than either, and the temporal ridges are very obsolete and do not unite posterior to the orbits, as in *E. elegans*, resembling in this respect the *E. nematodon*. The parietal region is wide and flat above. The interorbital region is only moderately contracted. The muzzle is rather short as compared with the total length of the skull. The interorbital region is gently convex above, and the top of the muzzle is flat. The zygoma is quite slender, and the otic bullæ are large and prominent. The notch of the palate extends as far forwards as the posterior part of the last superior molar. The infraorbital foramen is very large and round.

The anterior face of the superior incisor is nearly plane, and it is marked by a weak groove near the inner and a strong groove near the external border. In *E. elegans* this face is convex and without grooves. The molars are rather small for the size of the skull; their crowns are worn by use. The third is subround in section, and its diameter is about half that of the first; the latter has the anterior odd lobe quite small.

*Measurements.*

| | M. |
|---|---|
| Total length of skull | .0380 |
| Length (axial) to front of orbits | .0140 |
| Length (axial) to palatal notch | .0190 |
| Length (axial) to first molar | .0120 |
| Width at otic bullæ | .0205 |
| Width at middle of zygomata | .0220 |
| Width of interorbital space | .0060 |
| Width between first molars | .0055 |
| Length of molar series | .0070 |
| Length of first molar | .0030 |
| Width of superior incisor | .0015 |

This species is dedicated to my friend W. N. Lockington, the well-known naturalist of San Francisco.

SCIURUS BALLOVIANUS sp. nov.

This squirrel is the second species of its genus supposed to occur in the Truckee beds of Oregon, and the third *Sciurus* obtained thus far from the Lower Miocene or Oligocene of the West. The typical specimen fortunately includes the cranium, with both rami of the mandible, so that its reference to the genus *Sciurus* rather than to *Gymnoptychus* is assured. Like the latter genus, the infraorbital foramen is reduced to a slit, but, unlike it, there is but one internal tubercle of the crowns of the superior molars instead of two.

The skull is flat above, and the interorbital space is also flat, and is remarkably wide. Temporal ridges none. Muzzle short and narrow. Palate wide, its posterior notch extending as far forwards as the last superior molar. The ascending ramus of the mandible originates opposite the anterior part of the last inferior molar. The massateric fossa extends to opposite the anterior border of the second inferior molar. The mental foramen is near the superior border of the posterior part of the diastema. The second and third superior molars, the only ones preserved, have two cross-crests and a strong anterior cingulum. The external extremities of the cross-crests are little elevated, and there are no other cingula. The inferior molars have basin-shaped grinding faces, with a lobe at each angle. There is a small tubercle between the lobes of the inner and outer pairs. The incisors of both jaws are much compressed, strongly convex in front, and, in the lower jaw at least, without sculpture.

*Measurements.*

| | M. |
|---|---|
| Length of skull to orbit | .0090 |
| Width between orbits | .0090 |
| Width of muzzle | .0047 |
| Width between last molars | .0040 |
| Length of superior dental series | .0054 |
| Diameters of second molar { antero-posterior | .0015 |
| Diameters of second molar { transverse | .0016 |
| Width of superior incisor | .0013 |
| Length of mandibular ramus | .0150 |
| Elevation of ramus at coronoid | .0080 |
| Length of diastema | .0030 |
| Length of inferior dental series | .0070 |
| Depth of ramus at second molar | .0045 |

This species is much smaller than the *Sciurus vortmani*, from the same horizon of Oregon. The type specimen was discovered by Mr. L. S. Davis, of Mr. Wortman's party. The name is given in honor of Mr. M. H. Ballou, of Chicago, a naturalist and journalist.

CANIDÆ.

Species of this family were very abundant during the Miocene period in North America as in Europe. Those of the Lower and Middle Miocene epochs belong to genera allied to, but distinct from, *Canis;* while those of the Upper Miocene (Loup Fork) and later horizons, per-

tain to the latter genus, with few exceptions. The characters of the genera are as follows:

I. Molar formula $\frac{4}{4}$ $\frac{3}{3}$.
  Humerus with epitrochlear foramen ..... *Amphicyon.*
II. Molar formula $\frac{4}{4}$ $\frac{3}{3}$.
  Humerus with epitrochlear foramen.
    Inferior sectorial heel trenchant ..... *Temnocyon.*
    Inferior sectorial heel basin-shaped ..... *Galecynus.*
  Humerus without epitrochlear foramen.
    Inferior sectorial heel basin-shaped ..... *Canis.*
III. Molar formula $\frac{3}{3}$ $\frac{2}{2}$.
  Heel of inferior sectorial trenchant ..... *Enhydrocyon.*
IV. Molar formula $\frac{4}{4}$ $\frac{1}{2}$.
  Heel of inferior molar basin-shaped ..... *Icticyon.*
V. Molar formula $\frac{4}{3}$ $\frac{1}{1}$.
  First inferior molar two-rooted ..... *Hyænocyon.*

To these genera I refer nineteen species of the American Miocenes.

AMPHICYON Lartet.

Bulletin Société Géologique de la France, 1836, vii, 217–220; Blainville, Comptes-Rendus, 1837, v, 434; L'Institut, 1837, v, 18–19; Blainville, Osteographie, ix, Subursus, 78–96.

Dental formula: I. $\frac{3}{3}$; C. $\frac{1}{1}$; Pm. $\frac{4}{4}$; M. $\frac{3}{3}$. The true molars of the superior series all tubercular; the last two of the inferior series also tubercular. First inferior true molar a sectorial, with an internal tubercle and a heel with a superior groove, bounded by raised borders. Humerus with an epitrochlear arterial foramen.

Much is yet to be desired in the elucidation of the characters of this genus, especially of the American forms, which are less abundant and of smaller size than those of Europe. The typical species, *Amphicyon major* Blv. was the largest, equalling a bear in size. It is derived from the Miocene of Sansan, and a smaller form of it is found, according to Pomel, at San Gerand-le-Puy. Other species are derived from the latter locality, and all are typical of the Miocene formation in Europe. In the "Mio-pliocene" of India a single species has been discovered, the *A. palæindicus* of Lydekker. Three species occur in the Lower and Middle Miocene of North America, the largest of which about equals the wolf in size. On account of the large development of the inferior tubercular teeth, I have suspected that the *Canis ursinus* Cope, from the Loup Fork group of New Mexico, would prove to be an *Amphicyon*. If so, it is the only representative of this genus in our Upper Miocene.

The three American species differ as follows: The *A. cuspigerus* is small, not exceeding the kit-fox in dimensions. The *A. hartshornianus* is about the size of the coyote, and has rather small tubercular molars, especially of the lower series. The *A. vetus* is a little larger, but has the tubercular molars disproportionately larger than those of the *A. hartshornianus*.

TEMNOCYON Cope.

Paleontological Bulletin, No. 30, p. 6, December 3, 1878; Proceedings American Philosophical Society, 1878, p. 68.

Dental formula: I. $\frac{3}{3}$; C. $\frac{1}{1}$; Pm. $\frac{4}{4}$; M. $\frac{2}{3}$. Two molars in each jaw tubercular. Inferior sectorial with well-developed heel, which is keeled with a cutting edge above. An internal tubercle of the same. A postglenoid, but no postparietal foramen. Humerus with an epitrochlear arterial foramen.

The characters on which I rely at present for the discrimination of this genus from *Canis* are two. The first is the presence of a cutting edge on the superior face of the heel of the inferior sectorial, in place of a double row of tubercles surrounding a basin. When well developed, these characters present a broad contrast, but indications of transitional forms are not wanting. Thus, in some extinct *Canes* the internal crest of the heel is less elevated than the external, which is the homologue of the single crest of *Temnocyon*, and in some specimens of *Temnocyon coryphæus* there is a cingulum on the inner side of the median keel, which represents the internal crest of *Canis*. Secondly, the epitrochlear foramen of the humerus, a character common to all of our Lower Miocene *Canidæ* yet known.

The keel of the sectorial, which defines this genus, is simply a repetition on that tooth of the heel which belongs to the posterior premolar teeth of many *Carnivora*. It finds resemblances in such Eocene forms as *Mesonyx* and *Palæonyctis*. Among recent *Canidæ* it is apparently unknown, and is very rare in other groups. The *Cynodictis crassirostris* Filhol, from the French Phosphorites, strongly resembles the species of *Temnocyon* in generic characters.

Three species of the genus are known to me. They may be distinguished as follows. A fourth species, *T. josephi*, is provisionally placed with these:

I. First superior tubercular molar with a wide median fossa, bounded within by a tubercle.
  Length of superior molar series from canine, .070; of true molars, .0215. *T. altigenis.*
  Length of molar series from canine, .067; of true molars, .014. *T. wallovianus* sp. nov.

II. First superior tubercular molar with narrower basin, bounded within by a V-shaped crest.
  Length of dental series from canine, .055; of true molars, .014 ..... *T. coryphæus.*
  Length of dental series from canine, .051; of true molars, .013; muzzle narrow, zygomas wide ..... *T. josephi* sp. nov.

All of the above species have been derived from the Truckee Miocene beds of Oregon. I, however, anticipate the discovery of these or other species of the genus in the White River beds of Dakota and Colorado.

GALECYNUS Owen.

Quarterly Journal Geological Society London, 1847, iii, 54-60.—"*Cynodon* Aymard, Annales Société du Puy, 1848, xii, p. 244.—*Cynodictis* Bravard et Pomel, Notice sur les Ossemens Fossiles de la Debruge, 1850, p. 5.—*Cyotherium* Aymard, Ann. Soc. d'Agric. du Puy, 1850, xiv, p. 115"; Bronn.

Dental formula: I. $\frac{3}{3}$; C. $\frac{1}{1}$; Pm. $\frac{4}{4}$; M. $\frac{2}{3}$. Inferior sectorial with internal tubercle, and with a heel with raised or tubercular internal and external borders. First premolar in both jaws one-rooted. A postglenoid but no postparietal foramen. Humerus with an epitrochlear arterial foramen.

This genus, which is abundantly represented by species and individuals, existed during the Upper Eocene epoch in Europe (in the Phosphorites), and also during the White River or Oligocene in North America. As the structure of the feet of the numerous species from these epochs is not yet known, and, therefore, some doubt as to their correct generic reference may still exist, I only regard the genus as a certain inhabitant of North America during the Truckee or Middle Miocene epoch. This is indicated by the *Galecynus geismarianus*, where the number of the toes on the posterior foot has been ascertained.

All the species of the genus from Eocene and Lower Miocene beds, as well as most of those of the Loup Fork epoch, are characterized by the relatively small size of their sectorial teeth. In this they resemble the *Amphicyons*, *Temnocyons*, and other forms of *Canidæ* of the same period, and differ from such true *Canes* as *C. ursinus*, *C. sævus*, and *C. haydeni*, which display the enlarged sectorial teeth of the existing species of the genus. Of course there is every gradation in this respect between the two types. In the older species the internal tubercle of the inferior sectorial tooth is more largely developed than in the later ones, thus approaching some of the species of *Viverridæ*, where it is still more largely developed. As in other characters, there are gradations in this also, so that neither in it nor in the relative size of the sectorials do I find ground for the separation of the species in question from the genus *Canis*, as has been proposed in the case of some of the species in Europe. Through the kindness of M. Filhol, I possess jaws of a number of the species found by himself and others in the Phosphorites of Central France, including the *Canis velaunus*, the type of the genus *Cynodon* of Aymard. These agree very nearly with the species of dogs from the American Miocene beds as to generic characters. Professor Owen, in the paper above cited, proposed to distinguish the genus *Galecynus* on account of the greater length of the pollex as compared with that found in the existing species of *Canis*. This character appears to me to be of an unsatisfactory nature, owing to the fact that gradations in the length of a digit are difficult to express with precision in other than a specific sense; and the gradations may certainly be expected to occur.

I find in the *G. geismarianus* a character which separates the genus from *Canis*, viz, the presence of the epitrochlear foramen of the humerus. In this point it agrees with *Amphicyon* and *Temnocyon*. I ar-

range cotemporary and generally similar species under the same generic head, as the most reasonable course in the absence of direct evidence.

The American species of *Galecynus*, then, may be arranged as follows:

I. Smaller species with little or no sagittal crest.

* Temporal ridges uniting close behind orbits; otic bullæ small.

Small; no external ridge on inferior sectorial ..... *G. gregarius* Cope.

** Temporal ridges uniting early; otic bullæ large.

Larger; no external ridge on inferior sectorial; teeth robust. *G. geismarianus* Cope.

Smaller; an external ridge on lower sectorial; teeth more robust. *G. latidens* Cope sp. nov.

*** Temporal ridges not uniting anteriorly; otic bullæ large.

Least; muzzle narrow; superior tuberculars wide; no external ridge on inferior sectorial ..... *G. lemur* Cope.

### HYÆNOCYON Cope.

Paleontological Bulletin, No. 31, 1879, p. 3 (Dec. 24); Proceedings American Philosophical Society, 1879, p. 372.

This genus rests on the characters furnished by a single species, which is represented by but few remains. Its family position is doubtful, and my reference of it to the *Canidæ* is only provisional. It may, so far as the evidence goes, be a member of the *Mustilidæ* or even of the *Felidæ*.

Dental formula: I. $\frac{3}{3}$; C. $\frac{1}{1}$; Pm. $\frac{4}{3}$; M. $\frac{1}{1}$. Last superior molar rather narrow, transverse. Inferior premolars all two-rooted, and with well-developed posterior cutting lobe. Inferior sectorial large, with heel. Probably no inferior tubercular tooth.

The characters above given agree with those of *Icticyon* in the superior series, but differ in the inferior in the absence of the Pm. I. and the M. II.

The only known species is the *Hyænocyon basilatus* (*Enhydrocyon basilatus* Cope olim.), from the Truckee beds of Oregon.

### ICTICYON Lund.

Kongl. Danske Vidensk. Selsk. Afhandl. naturvidensk. og math. Classe, ix, Deel, 1842 (October, 1841) fide Burmeister; Van der Hoeven Wissen. en natuurk. Verh. der Koninkl. Akademie Amsterdam, Deel iii; Burmeister Erlauterungen zur Naturgesch. Brasiliens, 1856, 2.—*Cynalicus* Gray, Ann. Magaz. Nat. Hist. London, xvii, no. 112, 293.—*Melictis* Schinz. Revue et Magaz. de Zoologie, 1848, 176, fide Burmeister.

The dental formula is, I, $\frac{3}{3}$; C. $\frac{1}{1}$; Pm. $\frac{4}{4}$; M. $\frac{1}{2}$. The single superior tubercular molar is similar in general to that of other *Canidæ*. The inferior sectorial has an internal cusp and posterior heel, the latter with a low cutting edge on one side. Inferior tubercular well developed. One existing and one extinct species have been found in Brazil, the latter in the caves. I described a species from the Miocene which I cannot separate from them generically. This is the *Icticyon crassivultus* Cope (Proceedings Academy Philadelphia, 1879, p. 190).

# Art. VIII.—On the Vertebrata of the Wind River Eocene Beds of Wyoming.

By E. D. Cope.

The Wind River, the principal source of the Big Horn, rises in the Wind River Mountains, in Western Central Wyoming, and flows through a bad-land region for a hundred miles. This region was explored by Dr. F. V. Hayden in 1858, who makes the following observations respecting it (American Naturalist, 1878, p. 831):

> Along the east side of the Wind River Mountains, and filling up the Upper Wind River Valley, is a great thickness of Tertiary strata that has been weathered into very remarkable forms, and which are known in the West as "bad lands". The strata are most beautifully variegated with various shades of pink or brick-red color, so that they sometimes remind one of the Jura-Trias red beds. This formation was described by me in 1859 in detail, and named the Wind River group. It covers a broad area in this region, extending from the source of Wind River to the Sweet Water Mountains, south, more than one hundred miles, and west an average width of one to five miles. The aggregate thickness of this group cannot be less than 5,000 feet. On the west side of the Wind River Mountains no formations older than the Wasatch group are found. This group rests, doubtless, on the Archæan nucleus, inclining at the base 5 to 10 degrees. All the older sedimentary rocks have been entirely swept away from the granites for a distance of 100 miles; while on the opposite or east side, all the corresponding strata are visible, from the Silurian to the Cretaceous The Wasatch beds cover a large part of the Green River Valley, especially about its sources.

During the past summer I sent a party into the Wind River Basin, under direction of Mr. J. L. Wortman, already well known from his numerous important paleontological discoveries in Oregon. This gentleman made a thorough exploration of the bad lands, and probably obtained all the fossils found on the surface in the region. The following list of forty-five species shows that the collection embraces nearly all of the characteristic types of the American Eocene, and that twenty-six species are new to science. Among the most remarkable of these I may cite the large flesh-eater *Protopsalis tigrinus*, the largest of the Eocene period yet known, and the Amblypod, *Bathyopsis fissidens*, an important addition to the forms of that peculiar order.

Mr. Wortman's explorations were not accomplished without accident, he having lost most of his outfit on his first crossing of the Wind River. The bad lands form a most forbidding region, mostly waterless, and at an elevation which is unfavorable to the sparse vegetation which is permitted by the dryness of the climate.

## PISCES.

1. CLASTES sp.
Scales of this genus are moderately abundant.

2. PAPPICHTHYS sp.
Vertebræ of this genus occur in the collection.

## LACERTILIA.

3. PLACOSAURUS.
A species probably of this genus is not rare; and vertebræ indicate two or three species of lizards.

## TESTUDINATA.

Tortoises are not abundant; a portion of the plastron of a species probably of—

4. DERMATEMYS—
Being the only determinable fragment procured by Mr. Wortman.

## CROCODILIA.

5. CROCODILUS sp.
Not very common.

## RODENTIA.

6. PLESIARCTOMYS BUCCATUS Cope.
Three individuals.

7. PLESIARCTOMYS DELICATISSIMUS Leidy.
Four individuals.

8. PLESIARCTOMYS DELICATIOR Leidy.
Eight individuals.

## CHIROPTERA.

9. VESPERUGO ANEMOPHILUS Cope.

American Naturalist, 1880, p. 745.

Represented by the anterior part of a skull without lower jaw. Dentition: I.?; C. 1; Pm. 2; M. 3. Posterior molar narrow, its posterior external V rudimental; first and second molars subequal. Fourth premolar elevated and acute, with an external basal cingulum; second premolar simple, acute. Profile steeply elevated behind orbital region, less steep in front of it; zygomas wide. Length from interorbital region to above canine alveolus in front, .010; interorbital width, .005; width of zygomas, .012; width between outsides of last molar teeth, .010; length of molar series, .008; length of true molars, .004.

## BUNOTHERIA.

### TÆNIODONTA.

10. CALAMODON CYLINDRIFER sp. nov.

The only individual of this species discovered by Mr. Wortman is represented by fragments of the jaws, with several teeth, both loose

and imbedded in matrix. The former show that the molars have but one root. The latter include the large rodent-like incisors in a fragmentary condition, and a nearly complete tooth intermediate in character between the flat-banded teeth and the molar teeth of the known species of *Calamodon*. It may occupy an intermediate position in the jaw, but I do not know of any appropriate place for it in the mandible of *Calamodon arcamœnus*. I think there is little doubt the individual belongs to a species with narrower teeth than any of those of the two species already named.

The characteristic tooth in question is nearly cylindric, and the part preserved is quite long and slender. Its grinding surface is worn concavely, as in the flat teeth of the known species of *Calamodon*. The enamel is in two bands, one wider than the other, and each of equal width throughout. The space of cementum separating them on one side is nearly twice as wide as that on the other. The cementum layer is not so thick as in the species of the genus hitherto described. The shaft of the tooth is slightly curved, and the wider band of cementum is on the inner side of the curve.

*Measurements.*

| | M. |
|---|---|
| Width of enamel of large incisor | .018 |
| Length of shaft of cylindric tooth | .041 |
| Diameters of grinding surface of cylindric tooth, antero-posterior | .011 |
| Diameters of grinding surface of cylindric tooth, transverse | .010 |

INSECTIVORA.

11. ESTHONYX ACUTIDENS sp. nov.

The largest species of the genus, and represented by two individuals. The first of these includes the last molars of both series and an anterior true molar; the second includes most of the dentition of one maxillary bone, the last true molar being probably the only tooth missing. Four of the molars of this specimen are in place, and three are loose. Under the circumstances, I estimate seven molars, of which the fourth premolar is like the first true molar, and the third premolar has its internal lobe very much reduced. The two preceding premolars have one root, and short, compressed, and acute crowns. The second is abruptly very much smaller than the third, and is close to it; the first is close to the second, and is a little larger. The canine is larger still, and is somewhat compressed. Externally viewed, it looks like the canine of a carnivorous mammal; but viewed from within, it displays marked peculiarities. It has here a median rib, separated from the fore and aft edges of the crown by a groove. This ridge is without enamel, and the edges are produced and very sharp. The enamel of the external face extends twice as far towards the base as on the interior side. The enamel of this tooth, with that of the premolars, is wrinkled; that of the molars is smoother.

The details of the inferior teeth preserved do not differ much from those of the *E. bisulcatus*, excepting that the heel of the last true molar is much more produced.

The *E. acutidens* is considerably larger than either of the species of the genus heretofore described.

*Measurements.*

No. 1.

| | | M. |
|---|---|---|
| Diameters of last inferior molar | vertical | .0065 |
| | anteroposterior | .0130 |
| | transverse | .0064 |
| Diameters of a true molar | anteroposterior | .0095 |
| | transverse | .0074 |
| Diameters of last superior molar | anteroposterior | .0097 |
| | transverse | .0130 |

No. 2.

| | | |
|---|---|---|
| Length of five superior molars preserved | | .0410 |
| Length of premolar series | | .0325 |
| Length of bases of Pm. I and II | | .0125 |
| Diameters of Pm. III | anteroposterior | .0097 |
| | transverse | .0098 |
| Diameters of first true molar | anteroposterior | .0086 |
| | transverse | .0133 |
| Anteroposterior width of base of crown of canine | | .0080 |
| Transverse width of base of crown of canine | | .0050 |

12. ESTHONYX SPATULARIUS Cope.

American Naturalist, 1880 (Nov. 25), p. 908.

Represented by five molar and premolar and two incisor or canine teeth, apparently belonging to one individual. These are about the size of those of *E. bisulcatus*, but present several differences of detail. Thus, the basin of the heel of the last inferior molar is not obliquely cut off by a crest which extends forwards from the heel, but is surrounded by an elevated border, which rises into a cusp on the external side. The incisor-canine teeth are more robust than those of *E. bisulcatus*, one of them especially having a spoon-shaped crown, with the concave side divided by a longitudinal rib, on which the enamel is very thin. The enamel descends much further down on the external than the internal side of these teeth. The rodent-like tooth does not accompany the specimen. Length of base of last inferior molar, .009; width anteriorly, .005; length of crown of canine-incisor No. 1, .009; width at base, .005; length of crown of second canine-incisor at base, .012; width, .006.

MESODONTA.

13. HYOPSODUS PAULUS Leidy.

Numerous specimens.

14. HYOPSODUS VICARIUS Cope.

Less abundant.

15. PELYCODUS JARROVII Cope.

A jaw fragment supporting the last two molars presents the characters and dimensions of this species. The genus *Pelycodus* differs from *Tomitherium* in that the second premolar resembles the later ones in having two roots instead of having but one root like the first, as is found in the latter genus.

16. PELYCODUS TUTUS Cope.

*Tomitherium tutum* Cope, Report Expl. Surv. W. of 100th Mer. under Capt. Wheeler, iv, pt. ii, p. 141.

Represented by numerous specimens.

17. PELYCODUS NUNIENUM sp. nov.

Fragmentary jaws of six individuals of this species were found by Mr. Wortman. They indicate a species intermediate in dimensions between the *P. tutus* and *P. frugivorus*, which is further defined by the form of the last inferior molar.

The best preserved ramus supports all the teeth posterior to and including the third premolar. The last-mentioned tooth has an elevated acute crown, without any anterior basal tubercle, and a very short posterior heel. The fourth premolar is very stout; its cusps are not much elevated, and the heel is short. The anterior basal tubercle is quite small. All of the true molars have a second cusp in front of the anterior interval, but it is quite small, excepting on the first, where it is more distinct. The external crescents of all the molars are well defined, but the posterior does not inclose the crown behind with an extension of its horn. The last molar is a little longer than the others, and its posterior border is produced into two cusps. A simple raised border is found here in *P. frugivorus*.

*Measurements.*

| | M. |
|---|---|
| Length of molar series from third premolar, inclusive | .0228 |
| Length of true molars | .0150 |
| Diameters of first true molar { anteroposterior | .0050 |
| Diameters of first true molar { transverse | .0038 |
| Diameters of last true molar { anteroposterior | .0065 |
| Diameters of last true molar { transverse | .0040 |
| Depth of ramus at Pm. III | .0095 |
| Depth of ramus at last true molar | .0095 |

18. PANTOLESTES SECANS sp. nov.

Represented by the adherent rami of a mandible, on both of which the posterior four molar teeth are preserved.

The species is about the size of the *P. chacensis*, and hence larger than the *P. longicaudus*. It differs from both in the proportions of its teeth, and especially in the large size and sectorial character of the fourth premolar. The length of the latter exceeds a little that of the third true molar, while in the other species it is shorter. This length is caused by the extent of the anterior basal tubercle and posterior heel. The latter

is entirely surrounded by a cingulum, and its median line is elevated into a blade, which is continuous with the posterior edge of the principal cusp. Both edges of the anterior tubercle are also trenchant. The two cusps of the anterior inner tubercle of the first and fourth molars are well developed, but on the second molar there is but one cusp. This is probably a character to be relied on in distinguishing the species from the *P. chacensis*. No external basal cingula; enamel smooth.

*Measurements.*

| | M. |
|---|---|
| Length of last four molars | .0218 |
| Length of fourth premolar | .0068 |
| Elevation of fourth premolar | .0040 |
| Length of last true molar | .0057 |
| Depth of ramus at first true molar | .0070 |

As is the case with the species of *Pantolestes* already known, the *P. secans* seems to have been rare.

19. MICROSYOPS SPEIRIANUS Cope.

American Naturalist, 1879, p. 908.

Established on a portion of a mandibular ramus which contains the three true molars in perfect preservation. As the number of premolar teeth is unknown, its reference to this genus is provisional only. The last true molar has the form of that of the *M. gracilis* Leidy. It is distinguished by its very small size, since it is considerably less than the *H. vicarius* (*H.? minusculus*), and by the equality in size of the molars. The heel of the third molar is very small, and the two cones of the inner side of the crowns of all the molars are acute. The external crescents are very well defined, the anterior sending a horn round the anterior extremity of the crown. The posterior is connected with the corresponding internal tubercle by a median conic posterior tubercle. Length of true molar series, .008; length of second molar, .0026; width of second molar, .0022; length of last true molar, .0025; width of last true molar, .0016; depth of ramus at second molar, .0043. Dedicated to my friend Mr. Francis Speir, of Princeton, N. J., who, in connection with Messrs. Scott and Osborne, has made important additions to our knowledge of the Eocene *Vertebrata*.

20. MICROSYOPS GRACILIS Leidy.

Represented by numerous jaws.

21. MICROSYOPS SCOTTIANUS sp. nov.

A nearly entire left mandibular ramus is all that I have seen of this species. The crowns of the fourth and sixth molars furnish the only dental characters available, but the number and forms of the bases of the others are readily ascertainable.

The ramus of the jaw is more slender than in *M. gracilis*, and the last true molar has quite a different form. Instead of being shorter than in

allied species, this tooth is rather longer, evidently in consequence of a well-developed heel. The fourth premolar has a strong inner tubercle, and no anterior cusp or cingulum. Its heel has an elevated posterior border, enclosing a fossa with the principal cusps. No external or internal cingula. Third premolar with two roots. Alveolus of the second, large and apparently simple; it is filled with matrix. Canine large, directed forwards, and occupying all the space between a short diastema and the symphysis. The latter extends posteriorly to below the anterior part of the third premolar. The ramus is compressed and maintains an equal depth to the end of the molar series. Its inferior border descends below the coronoid process, and is not incurved, but the external face is convex. The anterior masseteric ridge is well marked, descending to below the middle of the ramus. Masseteric fossa flat. Mental foramen below the third premolar.

*Measurements.*

| | M. |
|---|---|
| Length of the fragment of ramus | .0435 |
| Length of dental series without incisors | .0280 |
| Diameters of canine { antero-posterior | .0040 |
| Diameters of canine { transverse | .0025 |
| Length of premolar series | .0100 |
| Length of fourth premolar | .0040 |
| Width of fourth premolar behind | .0027 |
| Length of true molar series | .0136 |
| Length of last true molar | .0052 |
| Width of last true molar anteriorly | .0030 |
| Depth of ramus at third premolar | .0090 |
| Depth of ramus at last molar | .0090 |

This species is dedicated to my friend Prof. William B. Scott, of the College of New Jersey.

CREODONTA.

22. MIACIS CANAVUS sp. nov.

Established on the mandibular rami of two individuals, which display the roots and some of the crowns of all the teeth exclusive of the incisors.

The root of the canine indicates that the crown is of large size and compressed at the base. The first premolar is one-rooted, and is separated from the second by a short diastema. The second has two well-distinguished roots, which are separated from those of the third by a diastema like that in front of them. Posterior to this there are no diastemata. The second root of the fourth premolar is much larger than the anterior. The sectorial, though the largest tooth, is of but moderate dimensions; its heel supports two posterior tubercles. The first tubercular is a little shorter. It has a raised border, and the anterior part two angular tubercles. The second tubercular is a very small tooth, but has two roots, the posterior of which is posterior to the anterior border of the ascending ramus.

According to Leidy's measurements, this species is about the size of his *M. vorax* of the Bridger formation. That species has, like the two others of that horizon, a second tubercular tooth with only one root.

*Measurements.*

| | M. |
|---|---|
| Length of dental line posterior to canines | .0440 |
| Length of premolar series | .0250 |
| Length of base of fourth premolar | .0065 |
| Length of base of sectorial | .0085 |
| Length of base of first tubercular | .0060 |
| Length of base of second tubercular | .0040 |
| Depth of ramus at second premolar | .0150 |
| Depth of ramus at second true molar | .0100 |

This species was probably about the size of the gray fox.

23. MIACIS BREVIROSTRIS sp. nov.

This species differs from those of the Bridger epoch in the same way that *M. canavus* does, *i. e.*, in the biadicate last inferior molar. Its dimensions are intermediate between those of *M. edax* and *M. vorax*, hence a little smaller than those of the *M. canavus*. This difference is partially seen in the shortening of the premolar series of teeth. They are closer together than in the *M. canavus*, and the roots are larger. The sectorial tooth is shorter. The fourth premolar has a low anterior basal cingulum; the posterior part of the crown is robust. The first tubercular molar is wide, and consists of a basin-shaped heel and a short anterior portion which is more elevated. The latter consists of two cusps, which are connected by an anteriorly convex ledge, but there is no third anterior tubercle as in *M. parvivorus*. The ramus is quite robust, and the basis of the canine tooth is unusually large. Mental foramina are below the anterior parts of the second and fourth premolars, respectively. Last inferior molar small.

*Measurements.*

| | M. |
|---|---|
| Length of molar series | .0380 |
| Length of premolars | .0200 |
| Length of base of fourth premolar | .0060 |
| Length of base of sectorial | .0072 |
| Length of base of first tubercular | .0048 |
| Length of base of second tubercular | .0042 |
| Depth of ramus at second premolar | .0140 |
| Depth of ramus at second true molar | .0140 |

24. DIDYMICTIS ALTIDENS Cope.

American Naturalist, 1880, Oct. p. 746.

Represented by several specimens. The species is larger than the *D. protenus*, or about equal to the coyote; but the tubercular molar is relatively smaller, and has the three anterior cusps better developed. The heel of the tubercular sectorial is longer and the three cusps more

elevated than in *D. protenus*. Diameters of latter tooth: Length antero-posteriorly, .015; length of heel, .006; elevation of external side of crown anteriorly, .015; width at same point, .009. Length of crown of tubercular, .009; width of same, .006; elevation anteriorly, .005.

25. DIDYMICTIS LEPTOMYLUS Cope.

American Naturalist, 1880, Dec. p. 908.

Represented by the posterior three inferior molars. These indicate a species of smaller size than the *D. protenus*, with the tubercular molar relatively narrower, and perhaps longer. The anterior part of the latter has the three cusps well defined and close together, and behind them is an oblique longitudinal cutting edge. The middle of the posterior margin rises into a tubercle. The anterior cusps of the tubercular sectorial are elevated; the heel has a strong external cutting edge and internal ledge. Length of tubercular sectorial, .009; width of same, .005; length of tubercular, .007; width of same in front,

26. DIDYMICTIS DAWKINSIANUS sp. nov.

This flesh-eater is represented by more or less imperfect mandibular rami of three individuals. The most complete of these lacks only the portions posterior to the coronoid process, and those anterior to the first premolar, and supports all the teeth excepting the first and second premolars. The premolars are all two-rooted excepting the first. The base of the fourth premolar is considerably longer than that of the third. Both of these teeth have a short posterior heel, and above it a cutting lobe. The fourth has a well-marked anterior basal tubercle. The heel of the sectorial is relatively short, and the anterior portion of the tooth elevated. The anterior and inner cusps are high, and about equal, but the external cusp is much higher. The external border of the heel is more elevated than the inner. The tubercular molar is elongate, and has a small triangular anterior portion somewhat elevated, in slight resemblance to the sectorial tooth. This portion consists of two opposite cusps and a lower one in front of the anterior inner, which connects with the external by an anterior ledge. The posterior portion has a tubercle on the external side, besides a posterior elevation. The ramus is rather slender, and the masseteric fossa is bounded by a prominent ridge in front, but fades out below.

The measurements show this to be the smallest species of the genus, being much less than the *D. leptomylus*.

*Measurements.*

| | M. |
|---|---|
| Length of dental series, including first premolar | .0265 |
| Length of premolar series | .0168 |
| Length of base of fourth premolar | .0055 |
| Length of base of sectorial | .0053 |
| Width of base of sectorial at middle | .0035 |
| Elevation of sectorial | .0055 |

| | M. |
|---|---|
| Length of first true molar | .0044 |
| Width of first true molar in front | .0028 |
| Elevation of first true molar in front | .0025 |
| Depth of ramus at second premolar | .0064 |
| Depth of ramus at tubercular molar | .0070 |

This species is dedicated to my friend Prof. W. Boyd Dawkins, the distinguished geologist and paleontologist, of Manchester, England.

27. STYPOLOPHUS STRENUUS Cope.

Portions of two individuals, with lower jaws, etc.

28. ICTOPS BICUSPIS Cope.

*Stypolophus bicuspis* Cope, American Naturalist, 1880, Oct. p. 746.

The genus *Ictops* was determined by Leidy from a species, the *I. dakotensis* Leidy, from the White River formation. The animal now mentioned is identical with it in generic characters, so far as they are ascertained. The *I. dakotensis* is established on a specimen which does not contain all the teeth, but the parts preserved indicate that those which are wanting are like the corresponding parts of *Leptictis* Leidy and *Mesodectes* Cope, with which the present species also agrees. It is unexpected to identify a genus found on the White River horizon with one from the Wasatch. *Ictops* agrees very closely with *Didelphys*. The fourth superior premolar has an internal cusp, which is wanting in *Didelphys*, and the inferior border of the mandible is not inflected. There are also but three superior incisors on each side. Under these circumstances I prefer to refer this genus to the *Bunotheria* rather than to the *Marsupialia*, but whether its proper place is in the Creodont or Insectivorous subdivisions I cannot yet determine.

*Char. specif.*—Smaller than the *Stypolophus minor* Filh., and not very different in dimensions from the *Ictops dakotensis* Leidy. It is represented by a nearly complete skull, with entire dentition of both jaws. Premaxillary bones rather elongate; general form of skull that of a civet. Crowns of second and third superior premolars compressed, with a prominent cusp behind the principal one. First and second true molars with two distinct external cusps and a strong external basal cingulum. Inferior first premolar one-rooted, third with a posterior heel, and fourth with strong anterior and especially posterior heels. Heels of true molars well developed (last broken). Length of superior dental series to I. 1, .031; length of molar series, .020; length of true molars, .006; depth of mandible at second true molar, .007; depth at canine, .0035. The double-lobed third premolar and the smaller size distinguish this species from the *Stypolophi*.

29. ICTOPS DIDELPHOIDES sp. nov.

Established on a left mandibular ramus, which supports the last three molars. This demonstrates the former existence of a species of larger

size than any of the *Leptictidæ* hitherto known. The general form of the inferior true molars is a good deal like that of *Stypholophus*, but they may be distinguished by three characters in which they at the same time, agree with the *Ictops bicuspis:* First, the elevated border of the heel, with a strong external cusp and weaker posterior and internal elevations; second, the small development of the anterior cusp; third, the posterior production of the heel of the third true molar, giving an indication of a fifth lobe. The external anterior cusp of the third molar is elevated; on the first molar it is less so, and the anterior cusp is small. The enamel is smooth, and there are no internal nor external cingula. The mandibular ramus is compressed and deep.

*Measurements.*

| | | M. |
|---|---|---|
| Length of bases of three true molars | | .0165 |
| Diameters of first true molar | anteroposterior | .0055 |
| | transverse behind | .0038 |
| Diameters of last true molar | anteroposterior | .0060 |
| | transverse | .0050 |
| Depth of ramus at anterior root of last true molar | | .0095 |

The jaw fragment described indicates a skull about the size of that of the common opossum.

30. PROTOPSALIS TIGRINUS Cope.

American Naturalist, 1880, p. 745.

*Char. gen.*—Probably *Oxyænidæ*,* but as the type species is only known from two true molars and a canine of the inferior series, with bones of the skeleton, this point remains to be ascertained. Femur with a weak third trochanter. Inferior molars: one like those of *Oxyæna*, *i. e.*, with large heel and internal cusp; another, probably the last-larger, without internal tubercle, and with a rudimental heel, thus resembling the inferior sectorial of various existing *Carnivora*.

*Char. specif.*—Size about that of the tiger or jaguar, exceeding that of any other flesh-eater of the Wasatch epoch. The heel of the smaller tubercular-sectorial is not large, and has a plano-concave superior surface. The principal cusp is much elevated, while the internal cusp is small. The sectorial differs from that of a *Hyæna* in having the posterior cusp more, and the anterior cusp less elevated; the heel is only a strong posterior cingulum, which is continued as a narrow line along the inner base of the tooth. A rough cutting ridge forms the posterior inner angle of the principal cusp. There is a wide longitudinal groove of the inner face of the inferior canine, whose enamel surface is impressed-punctate. The shaft of the femur is nearly straight. Diameters of crown of sectorial, anteroposterior, .025; transverse, .014; vertical, .022; length of heel of tubercular-sectorial, .006; width of same, .006; vertical diameter of base of crown of canine, .022; depth of mandible at last molar, .044; length of femur (condyles inferential), .300; diameter of shaft at middle, .034.

* See Proceed. Amer. Philos. Soc. 1880, July.

## AMBLYPODA.

### PANTODONTA.

31. CORYPHODON CUSPIDATUS Cope.

Part of the dentition of one individual.

32. CORYPHODON RADIANS Cope.

Apparently an abundant species.

### DINOCERATA.

33. BATHYOPSIS FISSIDENS gen. et sp. nov.

*Char. gen.*—These can only be given as seen in the mandible, the only part of the skeleton in my possession. Dentition: I. 3; C. 1; Pm. 4; M. 3. Incisors, canine, and first premolar forming an uninterrupted series, which is separated by a diastema from the molar series. The molar and premolar teeth are constructed on an identical pattern, presenting slight modifications from front to rear. This consists of an anterior elevated transverse crest, and a posterior heel with raised posterior border; between these is situated on the external side an elevated cusp, which sends a low ridge inwards and forwards. The inner extremity of the anterior crest is cusp-like, and is accompanied by a second internal anterior cusp immediately posterior to it. The mandibular ramus has great vertical depth, its inferior border being convex downwards throughout its entire length. Symphysis coössified.

The above characters indicate a new genus of considerable interest. Its form differs from that of the two genera where it is known, viz, *Uintatherium* and *Loxolophodon*, in the much greater development of the inferior expansion. In *Loxolophodon* it has been shown by Messrs. Speir and Osborne to be represented by a mere convexity. In *Uintatherium* Marsh has discovered it to be confined to the anterior part of the jaw, as in the sabre-tooth cats. In *Bathyopsis* it extends to the entire length of the ramus, giving an outline in profile much like that of *Megatherium*. The anterior extremity of the symphysis projects beyond the line of the anterior border of the inferior expansion.

The characters of the inferior molars in this and other genera of *Dinocerata* are very peculiar. In *Bathyopsis* they are constructed on the plan of those of insectivorous marsupial and placental mammals, so as to lead to the suspicion that its food consisted of crustacea, or insects of large size, or possibly of thin-shelled mollusca.

*Char. specif.*—This species was probably about the size of the Malayan tapir. The symphysis mandibuli is quite narrow, and its superior excavation is deep. It extends as far posteriorly as the middle of the diastema. It has considerable vertical thickness. The anterior edges of the lateral expansions are truncate, and present an obtuse angle outwards, which forms the anterior boundaries of the slight concavity of the lateral face. The middle of the expansion below the first premolar tooth is slightly convex. This wall encloses a large internal expansion of the

dental canal, which issues in a large mental foramen. This foramen is situated near the middle of the vertical diameter of the expansion, and below the anterior part of the diastema. It looks downwards and forwards. The external face of the posterior part of the ramus is nearly plane. The inner face is vertical to a line which corresponds with the inferior border in *Coryphodon*, and then slopes obliquely outwards to the inferior margin. The base of the coronoid process rises vertically from the line of the alveolar border, and its external edge forms an anterior border for the masseteric fossa. The inferior border of the fossa is not defined. The inferior border of the ramus is decurved posteriorly, and projects inwards considerably beyond the plane of the jaw.

The premolars differ from the molars in having all their diameters excepting the vertical, reduced. The fourth premolar only differs from the first true molar in the less elevation of the posterior border of the heel, and in a little smaller transverse diameter. The external part of the heel of the last molar rises into an obtuse cusp; the remainder of the border is tubercular. The heels of the other true molars end in simple recurved transverse edges. On the premolars their posterior extremities are not recurved. The anterior face of the anterior cross-crest of all the molars is concave, and on the second premolar it looks obliquely inwards. The posterior or second anterior inner cusp is obsolete on the second premolar. The enamel on all of these teeth is, excepting where worn, rather finely wrinkled. The first premolar is not preserved, but its alveolus indicates that it is one-rooted and rather robust. The sizes of the alveoli of the other anterior teeth are arranged in the following order, commencing with the largest: C.; I.2; I.3. The alveolus of the canine is compressed, and has more than twice the anteroposterior diameter of the largest incisor. The alveoli of the first and third are subround; that of the second is somewhat compressed.

*Measurements.*

| | | M. |
|---|---|---|
| Length from the middle of the second incisive alveolus to the extremity of the last molar | | .1950 |
| Length of the series of consecutive molars | | .1170 |
| Length of diastema | | .0240 |
| Diameter of alveolus of Pm. I | | .0090 |
| Diameter of alveolus of canine | | .0250 |
| Length of premolars | | .0460 |
| Diameters of Pm. II. | vertical | .0130 |
| | anteroposterior | .0130 |
| | transverse | .0090 |
| Diameters of Pm. IV | vertical | .0120 |
| | anteroposterior | .0105 |
| | transverse | .0120 |
| Diameters of M. I. | vertical | .0100 |
| | anteroposterior | .0155 |
| | transverse | .0110 |
| Diameters of M. III. | vertical | .0176 |
| | anteroposterior | .0260 |
| | transverse | .0180 |

The appearance of the ridges of the anterior part of the jaw of the *Bathyopsis fissidens*, together with the remarkably large dental canal and mental foramen, strongly suggest that the animal possessed a large and perhaps prehensile lower lip.

## PERISSODACTYLA.

### 34. PALÆOSYOPS BOREALIS Cope.

American Naturalist, 1880, p. 746.

Founded on a portion of the right maxillary bone, which supports the three true molars and one premolar. Size of *Limnohyus fontinalis*, or much smaller than *P. lævidens*. Anterior median tubercle well developed; anterior and posterior cingula strong, not rising to inner cones. A low ridge extending outwards and forwards from posterior cone. Enamel smooth. Differs from *P. junior* Leidy in the presence of the intermediate tubercle and crest, and in the weak external cingulum. Length of true molar series, .063; diameters of first true molar, anteroposterior, .019; transverse, .020.

Portions of several individuals were obtained by Mr. Wortman.

### 35. LAMBDOTHERIUM POPOAGICUM Cope.

American Naturalist, 1880, p. 748.

*Char. gen.*—Dentition much as in *Limnohyus*, excepting that there is a diastema in front of the second inferior premolar. Presence of first inferior premolar not ascertained. Fourth inferior premolar without posterior cusps. Superior molars with an angular ridge extending inwards from each inner cusp. Last inferior molar with heel. This genus differs from *Oligotomus* in the simplicity of the fourth premolar, which has in the latter two posterior cusps. The V-shaped crests of the inferior molars separate it from *Hyracotherium*.

*Char. specif.*—The heels of the second and third premolars have a median keel; the third only has an anterior tubercle. The crest of the heel of the fourth forms an imperfect V. Heel of the last true molar small. No cingula; enamel smooth. Length of molar series, .080; of true molars, .044; of last molar, .019; depth of ramus at first premolar, .021; at last molar, .031. Second specimen: Diameters of crown of last superior molar, anteroposterior, .014; transverse, .016. About the size of the *Hyrachyus agrestis*.

This species was probably the most abundant perissodactyle of the epoch of deposit of the Wind River beds.

### 36. LAMBDOTHERIUM BROWNIANUM sp. nov.

Considerably larger than the *L. popoagicum*, and about equal to the *Tapirus terrestris*. The greater part of a lower jaw represents the species, and on this unfortunately only one of the premolar teeth remains. The three premolars are all two-rooted, and the posterior lobe of the last true molar is well developed. The inferior part of the exter-

nal side of the ramus contracts or retreats rather abruptly posteriorly, below the last molar. It presents a slight external convexity below the second and third premolars. The alveolar line rises rapidly posteriorly, so that the last true molar is quite oblique. The second (first) premolar has a considerable heel, which is narrow and elevated on the middle line. The principal cusp is large and compressed, but obtuse, and has no anterior basal tubercle.

*Measurements.*

| | | M. |
|---|---|---|
| Length of six molars | | .090 |
| Length of true molars | | .055 |
| Diameters second (first) premolar | vertical | .009 |
| | anteroposterior | .012 |
| | transverse | .006 |
| Length of base of first true molar | | .015 |
| Width of base of first true molar | | .009 |
| Length of base of third true molar | | .023 |
| Width of base of third true molar | | .011 |
| Depth of ramus at second premolar | | .030 |
| Depth of ramus at M. III | at front of tooth | .039 |
| | at end of tooth | .047 |

Dedicated to my friend Arthur E. Brown, superintendent of the Philadelphia Zoölogical Garden.

37. PACHYNOLOPHUS CALCICULUS COPE.

*Lophiodon calciculus* Cope.

American Naturalist, 1880, p. 747.

Represented by lower jaws of two specimens. Transverse crests of inferior molars not connected by oblique ridges. Last true molar with a very small tubercle-like heel. A weak external basal cingulum; enamel smooth. Third and fourth premolars with wide heels, each with a single low ridge. Length of molar series, .053; of true molars, .033; of last true molar, .014; depth of ramus at penultimate molar, .025; diameters of penultimate superior molar at No. 2, antero-posterior, .012, transverse, .014.

This species is referred to *Pachynolophus* from its analogy to the *P. ventorum* in most respects.

38. PACHYNOLOPHUS VENTORUM Cope.

*Lophiodon ventorum* Cope, American Naturalist, 1880, p. 747.

Larger than the last, and differing in having a large heel of the last true molar, and an elevated external tubercle on the heel of the fourth premolar. Enamel wrinkled; no external cingulum. Second premolar with a very short heel with an acute tubercle. Length of molar series, .064; of true molars, .040; of last true molar, .016; depth of ramus at second premolar, .020; at third true molar, .030. Seven individuals in the collection, one with complete series of maxillary teeth. These in-

clude four premolars (the first one-rooted), so that the formula M. $\frac{4}{3}\frac{3}{3}$ is that of *Pachynolophus* Pom. rather than of *Lophiodon*. I refer another species to the same genus, by analogy, as it agrees in the dentition of the inferior jaw.

39. HYRACOTHERIUM ANGUSTIDENS Cope.

Apparently an abundant species. There are three sizes which I refer here, which may represent different species, but this cannot be determined without better material:

A. Depth of ramus at last premolar or first true molar, .0120; length of crown of first true molar, .0070; length of last true molar, .0100. Lower jaw of one specimen.

B. Depth of ramus, .0140; length of first true molar, .0065; of last molar, .0100. One lower jaw.

C. Depth of ramus, .0155; length of first true molar, .0075; of last true molar, .0100. Two individuals.

Portions of lower jaws of three other individuals in the collection are apparently referable to the *H. angustidens*.

40. HYRACOTHERIUM VENTICOLUM sp. nov.

*Hyracotherium vasacciense* Cope, American Naturalist, 1880, p. 747; not Report Expl. Surv. W. of 100th Mer. iv, p. 264.

Represented by an entire skull, with some bones of the skeleton, of one individual.

In general, this species is to be distinguished from its near ally, the *H. vasacciense*, by the slender mandibular ramus. The depth of this bone is about equal to that found in the larger varieties of the *H. angustidens*, but the teeth are much larger, having the proportions of those of the *H. vasacciense*. This remark applies especially to the last inferior molar.

The inferior canines form part of an uninterrupted series with the incisors. The superior canine is separated from the superior incisors by a diastema. The first premolar in both jaws is isolated. The second superior premolars have two cusps, and an internal ledge posteriorly. The third and fourth superior premolars are similar, the fourth displaying a little larger transverse diameter. The true molars are of subequal dimensions. Their external cusps are subconic. All the molars except the first and second premolars are entirely surrounded by a basal cingulum, which rises into a low cusp at the anterior external angle of the crown. The third inferior premolar has its two median cusps well separated and a wide posterior heel. The heel of the last premolar is wider, but carries no internal cusp. The external cusps on all the teeth wear into well-defined Vs. The posterior five molars have an external basal cingulum, but no other.

The mandibular ramus is compressed. The ascending ramus rises almost vertically a short distance posterior to the last molar. The symphysis is narrow, and extends to below the middle of the first premolar. The infraorbital foramen opens above.

*Measurements.*

| | | M. |
|---|---|---|
| Length of consecutive superior molars | | .04500 |
| Length of diastema between Pm. I and II | | .00350 |
| Length of second premolar | | .00700 |
| Width of second premolar posteriorly | | .00500 |
| Diameters fourth premolar | anteroposterior | .00700 |
| | transverse | .00900 |
| Diameters second true molar | anteroposterior | .00850 |
| | transverse | .01120 |
| Length of entire inferior premolar series | | .05800 |
| Length of entire inferior true molar | | .00282 |
| Diameters first true molar | anteroposterior | .00800 |
| | transverse | .00600 |
| Diameters last true molar | anteroposterior | .01200 |
| | transverse | .00650 |
| Depth of ramus at fourth premolar | | .01650 |
| Depth of ramus at third true molar in front | | .01650 |

The lower jaw of a second individual agrees with the type in its proportions.

41. HYRACOTHERIUM CRASPEDOTUM Cope.

American Naturalist, 1880, p. 747.

Size of *H. tapirinum*, but the tubercles of the inferior molars are not connected by cross-crests, and they all possess a strong external basal cingulum, which also extends round on the posterior base of the I and II true molars. Heel of fourth premolar with a diagonal ridge; two anterior cusps well separated, and no tubercle in front of them. Second premolar with narrow heel; last true premolar with wide heel. Length of molar series, .056; of true molars, .033; of last molar, .014; depth of ramus at second premolar, .018; at last true molar, .023.

This is the largest species of the genus found in the Wind River beds. Parts of two individuals were obtained by Mr. Wortman.

42. OROTHERIUM VINTANUM ("Marsh") Cope.

Report Expl. Surv. W. of 100th Mer. iv, p. 255.

A portion of the mandible of a single specimen, containing the characteristic fourth premolar and other teeth.

## ARTIODACTYLA.

A species of this order is represented by an astragalus. This is the first indubitable evidence of the existence of this order during the Wasatch epoch that I have seen. The following species are referred here provisionally only, as no part of their skeletons is known.

43. PHENACODUS VORTMANI Cope.

*Hyracotherium vortmani*, American Naturalist, 1880, p. 747.

This species is represented by portions of mandibles of four individuals. One of these supports the posterior four molars, another the posterior two, and another the last premolar and first true molar.

These indicate an animal of much smaller size than the *P. primævus*, but with a similar constitution of the molar teeth. The teeth support four conic cusps, which do not incline to fuse transversely, as is generally the case in *Hyracotherium*. Those of the posterior pair are separated by a tubercle, and a rudimental tubercle stands behind the notch between those of the anterior pair. The posterior median tubercle is developed into a heel on the last molar. On prolonged wear, the resulting pattern represents two Vs, the posterior limb of the posterior being regularly convex backwards. There are no cingula on any of the molars. The ramus is rather robust and is not deep.

*Measurements.*

No. 1.

| | M. |
|---|---|
| Length of bases of posterior five molars | .0440 |
| Length of bases of true molars | .0250 |
| Depth of ramus at Pm. III | .0160 |
| Depth of ramus at M. III in front | .0190 |

No. 2.

| | | |
|---|---|---|
| Diameters of M. II | anteroposterior | .0080 |
| | transverse | .0070 |
| Diameters of M. III | anteroposterior | .0080 |
| | transverse | .0055 |

The characters of the typical specimen are as follows: The jaw fragment indicates an animal of about the size of the *Hyracotherium craspedotum*, but with the opposite cones of the inferior molars not united by cross-crests. There is a tubercle between the posterior pair of the first inferior true molar. The anterior tubercles of the fourth premolar are close together, and there is a strong cusp anterior to these. No basal cingulum on this tooth. Length of molars 3 + 4 + 5, .025; depth of ramus at Pm. IV, .018.

44. PHENACODUS PRIMÆVUS Cope.

A fragment of a lower jaw, with teeth.

45. PHENACODUS TRILOBATUS Cope sp. nov.

A lower-jaw fragment, supporting the three true molars, of one individual, represents this species. It is of the dimensions of the *P. primævus*, and displays the same general constitution of the teeth. The only difference noticeable is an important one. The anterior internal tubercle is accompanied by two others of less elevation—the one immediately anterior, the other immediately posterior to and not deeply separated from it. The internal face of these tubercles slopes obliquely outwards on the second and third true molars. The external tubercles have their external faces sloping inwards on all the true molars. There are no cingula.

*Measurements.*

| | | M. |
|---|---|---|
| Length of true molar series | | .0390 |
| Diameters of first true molar | anteroposterior | .0107 |
| | transverse | .0097 |
| Diameters of third true molar | anteroposterior | .0130 |
| | transverse in front | .0100 |

GENERAL OBSERVATIONS.

Until the faunæ of the Wasatch and Bridger epochs are better known it will not be possible to fix the relation which that of the Wind River beds holds to them. It is, however, quite evident that in some respects it differs from both, both by what it possesses and what it lacks. In the following lists these differences are displayed so far as they relate to genera. The left-hand column represents the Wasatch, the middle the Wind River, and the right hand the Bridger.

| Wasatch. | Wind River. | Bridger. |
|---|---|---|
| *Clastes* | *Clastes.* | *Clastes.* |
| | *Pappichthys.* | *Pappichthys.* |
| *Crocodilus.* | *Crocodilus.* | *Crocodilus.* |
| *Plesiarctomys.* | *Plesiarctomys.* | *Plesiarctomys.* |
| | | *Myops.* |
| | *Vesperugo.* | ?*Vesperugo.* |
| *Calamodon.* | *Calamodon.* | |
| *Esthonyx.* | *Esthonyx.* | |
| *Ectoganus.* | | |
| | | *Anchippodus.* |
| | *Ictops.* | ?*Ictops.* |
| | | *Mesonyx.* |
| | *Miacis.* | *Miacis.* |
| *Didymictis.* | *Didymictis.* | ? |
| *Oxyæna.* | | ? |
| *Pachyæna.* | | ? |
| | *Protopsalis.* | ? |
| *Stypolophus.* | *Stypolophus.* | *Stypolophus.* |
| | *Microsyops.* | *Microsyops.* |
| *Pantolestes.* | *Pantolestes.* | *Pantolestes.* |
| *Pelycodus.* | *Pelycodus.* | ? |
| | | *Tomitherium.* |
| | | *Anaptomorphus.* |
| *Coryphodon.* | *Coryphodon.* | |
| | *Bathyopsis.* | |
| | | *Uintatherium.* |
| | *Palæosyops.* | *Palæosyops.* |
| | *Lambdotherium.* | ? |
| ?*Pachynolophus.* | *Pachynolophus.* | |
| *Hyracotherium.* | *Hyracotherium.* | ? |
| *Orotherium.* | *Orotherium.* | ? |
| | | *Hyrachyus.* |
| *Phenacodus.* | *Phenacodus.* | |

From the above it is evident that the Wind River fauna includes genera which have been hitherto restricted to either the Wasatch or Bridger lists. Of these, especially Bridger genera, there are six; that is, six genera which have not yet been detected in beds of the Wasatch epoch. On the other hand, there are nine genera which have been found in Wasatch beds and not in those of the Bridger. Three important Wasatch genera have not been found in the Wind River formation, while seven of the characteristic genera of the Bridger are not included in the list of those of the Wind River. The result, imperfect as it is, indicates a considerably greater conformity to the Wasatch epoch than to the Bridger in the faunal characters of the Wind River beds, and points to the confirmation of Dr. Hayden's views as to the identity of the two epochs.

The new species above described will be fully illustrated in the fourth volume of the Report of the United States Geological Survey of the Territories, F. V. Hayden in charge, now passing through the press.